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ILLUSTRATIONS.

Madonna and Child: Studies for a Painting for Church Decoration ..... By Mr. N. H. J. Westlake.
Palace of Charles V. at Granada ..... Drawn by Mr. A. T. Bolton, A.R.I.B.A.
La Giralda at Seville ..... Drawn by Mr. A. T. Bolton, A.R.I.B.A.
Reredos, St. Katharine's Chapel, Queen-square ..... Mr. John Medland, F.R.I.B.A., Architect.
Design for St. Luke's Church, Maidstone ..... Mr. W. H. Seth-Smith, F.R.I.B.A., Architect.
"Gilling Grove," Kendal ..... Mr. John F. Curwen, F.R.I.B.A., Architect.
Curate's Residence, Stanmore ..... Mr. John F. Curwen, F.R.I.B.A., Architect.

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An Imperial Lecture on Art.

WHETHER we like or do not like the Emperor of Germany, it must be admitted that he is the most dramatically interesting Sovereign who has sat on a European throne since the days of Napoléon. He is full of surprises; in the words of Falstaff, "one knows not where to have him." He is ready to set all the world right about everything, and his latest appearance has been as a lecturer on modern sculpture and its tendencies and temptations, on the occasion of his inviting to dinner all the sculptors who have been employed on the Avenue of Victory at Berlin. And to a considerable extent, at all events, Imperial lecture justified itself. It contained some very wise remarks, which are worth the attention of artists.

That the Emperor should have thought that the Avenue of Victory would be the astonishment of foreign visitors, and that German sculpture had shown itself to be equal to the sculpture of the Renaissance, is of course only what one must expect. That is the natural attitude of the Teuton mind. The Emperor would no doubt have fully sympathised with the gentleman who tried to stop Heine from speaking at a patriotic meeting, with the caution—"At this German meeting must the German German speak." So far we fear we cannot go with the Emperor. Whether an actual visit to the "Avenue of Victory" would convert us it would be rash to speculate, but our present impression of German sculpture is that it is marked by a certain rude and trenchant vigour combined with a lamentable want of refinement; and that as to any comparison with Renaissance art, Michelangelo's Medici tomb figures are by themselves worth more than all the united artistic genius of modern Germany could produce. But nevertheless it is a fine thing to see that Germany believes in her sculptors, as England — officially at least — does not. When one of the competitors for the Queen Victoria Memorial proposed to line his drocessional road from end to end with groups of sculpture, the leading journal asked, with a slight suspicion of a sneer, where we were to find the sculptors to produce all these works. The fact is that we are much better provided with sculptors for such a task than we have any reason to believe that Germany is. English sculpture has never been in so flourishing and hopeful a condition, artistically considered, as it is at this moment. Mr. Spielmann has just brought out a critical and illustrative book on contemporary English sculpture* which, in its numerous illustrations, affords a very good panoramic view of the recent productions of English sculpture; and no one, we think, can turn over its pages without being struck by the variety, originality, and refinement, of most of the work there represented. But these sculptors get little or no encouragement or employment from our Government. Herein the Emperor of Germany has set our rulers an example which they might well take to heart. He went, he said, on the principle that there should be direct relation between the artists and him who gave the commissions, without the intervention of the machinery of juries and committees. What the German artists thought of this we do not, of course, know. It is commonly supposed that in the multitude of counsellors there is safety, and to dispense with them was a somewhat daring, and would in this country probably be thought a too autocratic mode of procedure. But the Emperor seems to have done exactly the right thing. He gave the idea of what he wanted; with the assistance and advice of Herr Begas, and his own personal knowledge acquired from visits to a good many studios, he selected the artists; but having done so, he left each of them free to treat his own special subject in his own way, recognising that "every work of art implies some particle of the individual character of the artist." As a principle of procedure we do not see that he could possibly have done better; and though such personal management of such a matter on the part of the Sovereign would hardly be possible in our more constitutional country, nevertheless one cannot but feel that the spectacle of the Sovereign of a great country personally interesting himself in the production of a series of works of art for the adornment of his capital, selecting the artists and gathering them round him to have a talk about it when the work was completed, is in itself a wholesome and refreshing one, and does not in the least call for the sneering tone with which it has been commented on by some English journalists. The Emperor knows and cares more about art than they do, at all events.

The remarks which the Emperor made about modern art, after a reference to the opening of the collection of antique art at the Pergamon Museum, are particularly wise and well-timed. Sculpture, he said, still remained for the most part free from the influence of certain modern tendencies and movements; he evidently referred to the tendency to sensationalism which has so much beset modern painting—to the representation of ugliness rather than of beauty, in the search for novelty: and he urged his hearers to keep it so. Art that ignored the laws and limits of æsthetic beauty, so remarkably illustrated in the antique sculpture to which he had been referring, was no longer art; "it is a manufacture, it is an industry, which art must never become." Of no art is this more true than of sculpture, which is essentially an ideal, not a realistic art. French sculpture, though at its best it is still at the head of all, has been painfully invaded by this bane of sensationalism and realism, which, if not checked, will go far to ruin the art in France. Modern English sculpture, with all its variety and originality, has hitherto kept clear of this deteriorating influence; it is to be hoped that it will continue to do so; but in painting we are unfortunately not without too many examples of the kind of art which, as the Emperor says, "descends into the gutter" for its inspirations. Artists who follow this path, he thinks, whatever their talents, are on the wrong track. "If art, as is often the case nowadays, does nothing but depict misery in a guise even more hideous than the reality, it is sinning against the German people. . . . The art which descends to advertisement is no longer art, though it be extolled a hundred and a thousand times. The feeling for what is ugly or beautiful* is in every man, be he

* "British Sculpture and Sculptors of To-day." By M. H. Spielmann. London: Cassell & Co. 1901.

* We quote from the *Times* correspondent's report but probably what the Emperor really said (or at all events meant to say) was, the perception of the difference between the ugly and the beautiful.

ever so humble; and I need you all for the further cultivation of this sense among the people; and for having performed a piece of this kind of work in the Avenue of Victory I give you most especial thanks." Whether the Avenue of Victory sculptures are all that the Emperor takes them to be is a matter about which there may be differences of opinion; but at all events these are noble words to be addressed by a Sovereign to his artist subjects.

PUBLIC HEALTH AND HOUSING.

IN our issue of February 16 of this year we gave a brief synopsis of the history of the Housing Question in London, based on the special Report prepared by the London County Council, and expressed the conviction that the problem could only be effectually met by the combined efforts of public bodies and private enterprise; neither is alone sufficient to the task; and therefore that municipal authorities should not endeavour to crush out private enterprise. The question as to who should do it, however, though it is the first step in the matter, is after all hardly so important as the question how it should be done; and on this head the suggestions of an able medical man* who has made the hygiene of the dwelling a special study, are worthy of careful consideration.

The sub-title to Dr. Sykes's book evidently refers to the change which has gradually been developing from the house to the "flat" system. A "house" may indeed be let to different families on different floors, but the essential difference between a house and a flat is that in the former the sanitary conveniences are mostly all in the basement, in the "flat" they are provided, or may and should be provided, on the same floor with each dwelling. There are those who maintain that "flat" houses should have the latrines grouped on upper or lower floors, or even out of the building. We have always held that for reasons of privacy and order each habitation in a flat should contain within itself the necessary provision for everything in the household life except the washing of clothes, which is a business of only weekly occurrence. As Dr. Sykes puts it—

> "What chance has a respectable family of observing the decencies of life in a house where there are one or two dissolute families, where the domestic and sanitary conveniences are all used entirely in common, and the members of the respectable family, even the youngest, are continually traversing the house to and fro? If domestic and sanitary conveniences are provided on each floor, those living on that floor can at least cultivate their own good habits in their own way. What is wanted is to procure for families as much privacy as can be obtained, and to reduce the common usage to the smallest proportions possible."

In regard to considerations of order and decency this is obvious enough, but Dr. Sykes adds another argument the force of which is not so generally realised. In the case of families (and there are numbers of such cases) living on the top floors of houses some 40 ft. high, where the water-taps, sinks, water-closets and dust-bins are situated at the ground floor or basement, Dr. Sykes points out that it is usually assumed that twenty times more energy is expended in walking up stairs a certain height than in walking the same distance on the level:—

> "Therefore walking to the top of a four-story house is equivalent to walking about 800 ft. upon the level, and, say a cottage measures 15 ft. frontage, this is equivalent to walking past a row of over fifty-three cottages to reach the common sanitary conveniences above mentioned. What would be the opinion of a medical officer of health or of the Local Government Board if provision were as inadequately made even in a rural district? Yet this is the condition that prevails over a large part of London."

The case could hardly be more strongly or practically put. If it be said that in the cheapest class of tenements economy of structure demands the concentration of the water-closets, it may be replied that concentration can be made, to a certain extent, vertically as well as horizontally, and that water-closets, sinks, &c., may be combined in a tower or projection running through all stories and serving two tenements on each floor, with separate access. This is the method specially recommended by Dr. Sykes in the case of the structural adaptation of "floor" houses into "flats," but it might very well be applied to new houses built as flats.

To come back to the primary objects of Dr. Sykes's book, let us see what light he throws, from the medical point of view, on the question of the hygienic effect of the increasing tendency, among upper classes as well as lower classes, to live in flats rather than in separate houses. The fact that rate of mortality increases, in the main, with density of inhabitation per square area, has long been admitted; Dr. Sykes puts it that in consequence of the altered conditions arising from the increased use of dwellings in flats, we have now rather to consider density of inhabitation per cubic space. This may be a simpler way of dealing with statistics for the purpose of practical application, but we do not see that it really makes much difference. If there are twenty people in a four-story house where there used to be ten people in a two-story house of the same area the density per square area is doubled, and we do not see that the fact of their being piled one above another vertically materially modifies the case, for their relation to the amount of sun and air available around them (which is one of the most important factors in the matter of hygiene) is practically much the same. It seems to us, in fact, rather important to keep in view this aspect of the problem, because on it hangs the necessity (which we cannot for a moment doubt) of demanding that increased height in building should be accompanied by wider spacing between buildings. This is exactly one of the things which estate-owners or their agents in London cannot be made to see, and which the law ought to compel them to see, whether they will or no. In Bloomsbury, for instance, which according to statistics has figured as about the healthiest part of London, a considerable number of sites have recently been cleared of the old houses and rebuilt upon with houses in flats nearly or quite twice as high as the old houses, on the same amount of land. It is ridiculous to suppose that this can go on without affecting the health statistics of the district; and legislation ought to put a check upon it. It does not appear, moreover, from Dr. Sykes's statement, that there are at present any extensive statistics available in regard to rate of mortality in relation to density of cubic space inhabitation, at all events in London. Some statistics in regard to the proportion of the death-rate to the number of rooms in dwellings—which may be taken to represent approximately the relative size of the dwellings—are very significant. Dr. Sykes gives a table from Glasgow of the comparative death-rate in dwellings of "one and two rooms," "three and four rooms," and "five rooms and upwards"; the figures are respectively 27·74, 19·45, and 11·23. We have only space to give the totals; the table is classified for various diseases, but in some special forms of disease the difference is even more startling; in the case, for instance, of "nervous diseases and diseases of nutrition of children," the respective death-rates are 4·80, 2·35, 0·91. Here of course comes in the element of want of adequate separation, and the use of the same room for living and sleeping. It is a better hygienic condition to inhabit two small rooms than one large one on the same floor area. In dealing with statistics of persons per room, the author considers as "overcrowded" all dwellings in which the number of inhabitants is more than double the number of rooms. The following table gives the results in this respect for six of the capital cities of Europe:—

City and date.	Population.	Overcrowded population.	Percentage overcrowded.	Mortality of whole city.
London (1891)..	4,211,743	830,182	20 per cent.	21·4
Paris (1891)....	2,424,705	331,976	14 ,,	21·6
Berlin (1885) ..	1,315,387	363,960	28 ,,	24·6
Vienna (1890) ..	1,364,548	387,000	28 ,,	24·6
Budapest (1891)	463,759	348,609	74 ,,	28·0
St. Petersburg (1890)	956,226	442,508	46 ,,	28·4

Table showing relation of mortality to overcrowding of persons per room, in six capitals of Europe.

It is stated that the comparative results as between Budapest and Paris are not so different as appears at first sight, because in the Budapest returns only the actually inhabited rooms are taken, excluding lobbies and other apartments not permanently inhabited, whereas in the Paris returns all apartments within a tenement are included; therefore the proportion of overcrowding in Budapest may be exaggerated and that of Paris under the mark. This will not however entirely account for the much lower proportion of death-rate to overcrowding in London than in Paris, which may be fairly set down to the generally better sanitary state of London, owing to the sanitary reform and legislation of the last half-century.

In his chapter on the "Effects upon Health of Certain Kinds of Dwelling-Houses and Dwellings" Dr. Sykes disposes effectually of the attempts which have been made to defend back-to-back houses, showing that according to careful statistics as to comparative mortality in the same town, back-to-back houses have a mortality per 1,000, for all diseases, one-third higher than that for through houses. This seems unanswerable, and yet there are town authorities who will persist in defending, or excusing, this method of building, on grounds of so-called economy. Dwellings over stables are another class of habitations of which the mortality statistics in

* "Public Health and Housing: the Influence of the Dwelling upon Health in Relation to the Changing Style of Habitation." By John F. J. Sykes, M.D. London: P. S. King & Co. 1901

London, especially for infants, are very high. The mortality in these dwellings for infants under one year of age is, for all diseases, nearly double the general mortality at the same age for London; and for bronchitis and pneumonia it is more than double. Although we do not in any case favour or defend dwellings over stables, we do not see any necessity for such a death-rate as this if they were properly constructed, with solid impervious floors between the stable and the dwelling, and efficient through ventilation. In many cases, however (as those Londoners will know who happen to live in terraces looking on to the back of a "mews"), the houses are, in regard to through ventilation, in the same condition as back-to-back houses, the back wall being unpierced with windows, probably to prevent the depreciation of the better-class house property by having stable-dwelling windows overlooking their backs or their gardens; and in the case of the older buildings the floors between stable and dwelling are only boarded. This latter defect can easily be remedied now by concrete floors, but the question of the back windows is a difficulty that can hardly be got over, for there can be no doubt that their existence would amount to a serious depreciation of any terrace-house property on which they faced. The moral is that such dwellings should be discontinued, and the existing ones disestablished as soon as may be. The present London Building Act compels the interposition of the concrete floor in any new building of the kind, but it does not provide for through ventilation, since, as long as there is only one room in the width of the building, the required windows may all open towards the stable-yard. In a mews on a large scale, where there is room for an inclined plane to be worked in, the problem might perhaps be better met by building the stables in two stories and grouping the dwellings separately from them, since it is probable that a certain number of dwellings on the spot are practically a necessity.

In regard to such large blocks of artisans' dwellings as the Peabody buildings and others of similar type, statistics show that the general death-rate is lower in these than the average of London; but that on the other hand the death-rate for disease propagated by direct infection is higher; which is exactly what we should have expected. In regard, however, to the death-rate for all causes, Dr. Sykes is of opinion that the statistics for these buildings can hardly be taken as normal, inasmuch as they are occupied by what is really a selected population living under special conditions, and for this and other reasons any comparison between the statistics as to the houses demolished on an insanitary area, and the new buildings erected on the site, would be of little value.

On the other hand, some most important comparisons are made in regard to the health effect of different systems of fœcal removal: comparisons which, we are not surprised to find, are entirely in favour of the water-closet system—the only system, in our opinion, fitted for a civilised city. The advocates of the nasty system, as we do not scruple to call it, of pail-closets, should take to heart the statistics quoted by the author from the Report of Dr. Boobbyer, the Medical Officer of Health for Nottingham, in regard to the distribution of typhoid fever in Nottingham during ten years (1887 to 1896), in houses with different types of closets. This investigation showed that in midden-privy houses the proportional annual incidence was one case for every 37 houses; in pail-closet houses, one in 120; in water-closet houses one in 558: figures which require no comment. He found also—which is easily comprehensible—that the disease was much more liable to recur after it had arisen in the privy and pail-closet houses than in the water-closet houses:—

"Of the eleven third consecutive cases that occurred in single houses, three were in privy houses, eight in pail-closet houses, none in water-closet houses. Of the four fourth consecutive cases in single houses, all were in pail-closet houses. He pointed out that the closet-pail is essentially only a small portable privy above ground, and is capable of polluting the air, the soil, and the surroundings almost as much as the privy, especially by spilling and leakage in scavenging."

Dr. Sykes's chapters in regard to the arrangement of houses in streets contain nothing new, except that he draws attention usefully to the bad features of arrangements (illustrated by block plans) whereby the angle houses become back-to-back houses. In regard to blocks built in straight lines he also draws attention to the fact that "wherever there is a central wall or partition separating the front rooms from the back rooms," there is the type of the back-to-back dwelling. He means, we presume, wherever there is no direct opening between these front and back rooms, but only outer openings to them separately from a staircase. The common staircase, too, unless to some extent permanently open to the air, is a means not of ventilation, of communicating to one dwelling the air that has been breathed in another. Staircase windows ensure light, but not ventilation. In many cases they are never opened.

The author's remarks about the treatment of the ground adjoining houses are important and worth quoting:—

"With regard to the surface of the open spaces immediately contiguous to dwelling-houses, the soil in towns always becomes polluted and prejudicial to health. There are two ways in which it can be effectually dealt with: the one is by cultivation as a garden, the other is by impervious paving, so levelled and drained as to be readily cleansed. As a temporary expedient, the surface may be gravelled and rolled, but this is not of permanent benefit. Many small gardens in towns are merely barren wastes, and in deciding whether it is a garden or a yard, the test is whether it is regularly cultivated with grass or permanently paved. It should be definitely provided that such spaces should be regularly cultivated or permanently paved, instead of leaving it to vague by-laws that are difficult, if not impossible, to interpret."

If we ask what, amid all the useful suggestions as to details, is the general recommendation Dr. Sykes has to make to the housing problem, considering it in the light of providing sufficient and healthy dwellings for those who require them, it seems, though nowhere very clearly or consecutively stated, to amount to this:—That it is of no use to think that those who are turned out of insanitary property which has to be pulled down, can be provided for by the erection of buildings in far suburbs and the provision of increased and cheaper means of transport. They will not all transport their chattels to a distance; they want to be near their old neighbourhood and near their work. Nevertheless, he holds that demolition of insanitary and overcrowded property must always have a good effect. Its effect is "not only to destroy the houses, but also to disperse the worser elements among the better elements of the population;" in other words, to dilute the evil. On the other hand, a large number, not perhaps of the worst, are by the demolition driven into sublet houses unsuited to the use to which they are put. But these might be altered and adapted to their new usage at no very great expense; and in the effort to do this, to make the best of the houses available by altering and adapting them, Dr. Sykes thinks the greatest hope of regeneration lies. It is not what is called a heroic remedy; that it is so very simple and matter-of-fact is perhaps its best claim to attention.

NOTES.

Home and Colonial Stores *v.* Colls.

IN this appeal case in regard to right of light, which is reported in our legal column, it appears that the defendant has suffered from an unexpected and very hard measure on the part of the Appeal Court. In the first action, which was to restrain the defendant, a well-known builder, from erecting a building which it was contended would obstruct the ancient lights of the defendants, it appears that the principal claim was in respect of a large ground-floor window lighting an office where a number of clerks worked; but though these windows were of large size, it appears that the upper portion of them was filled 20 in. deep with stained glass, and the lower portion covered with horse-hair blinds, so that it would not seem that the demand for light was so very great after all. Mr. Justice Joyce, before whom the case was heard, found for the defendant, on the ground that there was no substantial injury to the plaintiffs' light. Plaintiffs gave notice of appeal; and meantime the defendant—it may be said, rather imprudently—went on with his building. The Court of Appeal has reversed the judgment, on grounds which appear in the report, and has ordered the defendant to pull down his building. This is where we consider the hardship occurs. The defendant took the risk of the reversal of judgment, but he probably never contemplated having to remove the building. Claims of this kind, as we have frequently pointed out, can be settled by compensation; and it has appeared that judges were rather disposed to take this view. The moral of the case is perhaps, that it is more prudent not to proceed with a building when there is an appeal pending; but to compel the defendant to pull it down seems to be an unnecessarily harsh procedure in the case of a damage to light which was at all events disputable, and savours rather more of law than justice.

Crystal Palace Gas Exhibition.

THE International Gas Exhibition which is now being held at the Crystal Palace cannot be regarded as worthy of the industry which it is supposed to represent, and many of the best-known firms of burner-makers and gas-stove manufacturers have no exhibits. In spite, however, of the limited scale of the exhibition, one or two novelties are shown which well merit attention. The Lucas incandescent intensive gaslight is exhibited for the first time in this country. This

lamp has met with great success in Berlin, and emits a white light of such brilliancy, that it is exceedingly conspicuous, although exhibited in close proximity to high-power incandescent gas lamps of the well-known type. The Lucas lamp is supplied with gas under ordinary pressure, and it is stated that with a consumption of 17 cubic feet of gas per hour a 700-c.-p. light is obtained. One of the essential features of the lamp is its chimney, which is about 3 ft. in length, and creates a strong upward current of air around the mantle and flame. Another exhibit which calls for special mention is the inverted incandescent gas lamp. In this lamp the burner is situated above the mantle, and has a cone of white porcelain to act as a radiator and reflector. The mantle is inverted and suspended from the burner, so that when properly shaded, the lamp closely resembles an incandescent electric lamp. It is claimed that this burner gives a light of from forty to fifty candle-power with a gas consumption of 3·4 cubic feet per hour, and although it is therefore less efficient than burners of the usual form, it is considered that this disadvantage is more than counterbalanced by the freedom from shadow and more pleasing appearance of the new lamp. It remains to be proved whether the mantles are as durable when applied to inverted burners as when used on burners of ordinary construction. Other noteworthy exhibits are the new Clamond gas radiators and the Welsbach self-intensifying lamps. A few stalls are devoted to acetylene appliances, but as these exhibits are not shown in action they are not of great interest. The exhibition will close on the 11th proximo.

Metrology.

The learned paper on the "Applications of Elastic Solids to Metrology," by Dr. Chree, the Superintendent of Kew Observatory, which appears in the *Philosophical Magazine* for this month, is a most valuable contribution to our scientific knowledge. The object of the paper is to exemplify the bearing of elasticity on physical measurements, and the author's unique knowledge of the mathematical theory of elasticity has enabled him to give a complete and systematic treatment of the subject. We are apt to regard a solid as something whose volume alters only with temperature. When, however, we make very accurate physical measurements it has to be remembered that bodies are elastic, and not rigid. Dr. Chree proves that the changes in the volume of the international standard kilogramme made of platinum iridium are appreciable owing to variations in the height of the barometer, and hence a standard pressure ought to be assigned at which a kilogramme has its normal volume. Hence, with the accuracy of measurement they are trying to attain at the National Physical Laboratory, they have to recognise that platinum is an elastic solid whose volume alters with the atmospheric pressure. The author, from the theory of elastic solids, deduces the difference in the volume of a glass tube when it holds mercury and when it holds water, and proves that this difference is very appreciable. Perhaps the most important of his results are those showing how standards of length alter owing to the fact that the bars on which they are marked are not absolutely rigid. Most modern standards of length are supported on two symmetrical rollers, as the bars have to be surrounded by liquid so as to promote uniformity of temperature, and hence the flexure of the bar has to be considered. Dr. Chree proves that the reaction of the supports possesses as yet only theoretical interest, but that the effect of barometric pressure has to be considered. At Kew the standard yard is the distance between the centres of two gold plugs let into a bar so that they lie flush with the upper surface. Dr. Chree gives the mathematical solution of the problem of finding the distances of the supports from the ends of the bar so that the distance between the plugs shall be unaffected by stretching.

Copper-Tin Alloys.

An important communication on the "Microscopical Examination of the Alloys of Copper and Tin" was made to the Institution of Mechanical Engineers on the 20th inst. by Mr. William Campbell, B.Sc., of Columbia University, New York. The work which led up to the writing of the paper was carried out in the metallurgical laboratory of the Royal School of Mines, and is supplementary to the Reports of the Alloys Research Committee. A number of experiments were detailed, with a view to explain the complete freezing-point curve of the copper-tin alloys published in the fourth Report of that committee; they also throw much light on the change of structure in those alloys due to casting. Perhaps the most interesting and original part of the communication consists in the description of the micro-structure of the alloys. Mr. Campbell finds that when the alloys which contain between 0 and 1 per cent. of copper are cast, the tin crystallises out as grains very much smaller than those of the slowly cooled alloys. The proportion which the grains bear to the entectic is greatly increased by casting, and this seems to point to the fact that in cooling quickly the grains of tin retain some copper. On the other hand, no crystals can be seen in the 1 per cent. alloy when cast, whereas when it is slowly cooled in the furnace they are present. This last principle is not, we may remark, a new discovery, for it has for years been known, in connexion with the cooling of igneous rocks, that de-vitrification, accompanied very frequently by the development of phenocrysts, takes place on slow cooling, whereas the same magma may become vitreous when rapidly cooled. The author states that when from 1 to 8 per cent. of copper is present casting produces a fine network of bright crystallites; the 20 per cent. alloy is composed of bright rod-like crystals which, under a magnification of some 300 diameters, are seen to be composed of two constituents, and the rods increase in size as the copper is increased to 40 per cent. With 41 per cent. of copper the crystals change in character, and become more or less fibrous in appearance. The surface structure of the alloys containing between 80 and 100 per cent. of copper is often very fine, and generally consists of numbers of distinct skeleton crystals which stand out prominently above the surface. The conclusion arrived at is that the result of casting is in all cases to make the structure comparatively minute. These researches by Mr. Campbell mark a distinct advance in metallurgical science, and they have considerable bearing on the subject of bronze-casting in general.

Cass's Charity, Aldgate and Hackney.

In 1709 Sir John Cass, Alderman of Portsoken Ward, made a will vesting in trustees some lands adjoining his house in Gover-street, South Hackney, together with a capital sum of 1,000*l.*, for the establishment and maintenance of an advanced or higher grade school at Hackney, and a charity school in his native parish of Aldgate. In 1718 he prepared another will that increased the yearly subsidy in favour of the Aldgate school. He did not live, however, to completely execute the later will, for whilst signing the second sheet he died with the pen in his hand. Considerable litigation ensued, and several years elapsed before Lord Chancellor Hardwicke gave judgment in favour of the former will; the Court of Chancery ordered that the income, 493*l.* per annum, of the trust should be expended upon the schools in Aldgate, the funds not being sufficient for the school at Hackney as well. In 1893-4 the Charity Commissioners formulated a scheme for the allocation of the funds of the endowment, which had so increased in value as to yield a yearly income of 6,500*l.*, which, it is computed, will ultimately reach nearly 30,000*l.* as the leases expire. The scheme apportioned a capital sum of 5,000*l.* and a sum of 500*l.* per annum for educational purposes in Hackney out of the surplus endowments at a future time as the property enhances in value, and continued the Cass's School, for 220 boys and girls, with their board and clothing, in Aldgate. The Commissioners further provided for the establishment in Aldgate of a Technical Day School and Institute in Jewry-street, Aldgate, for which Mr. Arthur W. Cooksey's designs and plans were accepted in a competition limited to five architects, Professor Aitchison acting as assessor, in conjunction with Sir Philip Magnus and Dr. Garnett of the Technical Education Board (see the view, section, and plans illustrated in the *Builder* of July 23 1898). In September last Mr. Blashill, as assessor, awarded the first premium in a limited competition to Mr. Cooksey in respect of his plans and designs for the North-East London Polytechnic buildings to be erected near Hackney Downs Railway Station, as part of the Cass foundation. In October a tender for 10,826*l.* was accepted from Messrs. Chessum & Sons, of Bow, contractors, for the new works.

Leeds and Yorkshire Architectural Society.

The Leeds and Yorkshire Architectural Society, which appears to be making new progress under its present energetic President, Mr. Butler Wilson, has followed the example of the Architectural Association and of some of the leading provincial societies in issuing an annual "Book," to be called "The Green Book," containing information as to the proceedings of the Society, its classes and meetings, its finances, &c. From the first issue of the "Green Book," which we have just received, we learn that the Council report a slight increase in the membership of the Society, which now numbers 119 members, as against 111 at the same date last year. The Report expresses regret that the competition for the Society's prizes was less keen than might be wished; we hope there will be a better record in this

respect in the future. The prizes offered are a silver medal and five guineas, offered by the President for measured drawings of any ecclesiastical or domestic building erected anterior to 1800 A.D.; the Society's prize of three guineas for the best design for a lodge and entrance gates; the Society's prize of three guineas for the best constructional drawing of a roof for a gymnasium or swimming-bath; and a prize of two guineas for the best essay on "Modern Street Façades in Leeds," illustrated with sketches as far as possible. That ought to be an attractive subject, and Leeds affords plenty of good examples.

Antiquities of Susa.

AT the London Institution on December 19, a lecture on the "Recent Discoveries at Susa" was delivered by Mr. W. St. Chad Boscawen. In Mr. Boscawen's brief summary of the progress of exploration on both banks of the Tigris, he referred to the excellent work of the French explorers, and dealt chiefly with the discoveries of M. De Morgan. The illustrations put on the screen consisted mainly of inscriptions, and as explained and translated by Mr. Boscawen prove the existence of an advanced civilisation much further back than any Babylonian records. In prehistoric times the stone written title-deeds of land grants, and the accounts of miscellaneous traders, show the existence of a perfect system of land survey and valuation and accurate bookkeeping. That certain parts of Elam were laid out in vast wheat-growing areas he claims abundant evidence. The lecturer drew an ingenious, though somewhat unconvincing, analogy from the remains of pottery evidently cast in a basket mould, and concluded that the art of basket-making was prior to that of the potter, and traced the subsequent surface decoration of pottery from this source. Architecturally, the most interesting slide was one of a rough pointed arch, discovered under a lease dated at 4000 B.C. A slide of a fragment of sculpture in low relief, dated 3800 B.C., representing the attack of the Elamites led by their king up the precipitous slopes of their enemies' position, is a piece of marvellously powerful pictorial sculpture.

THE ARCHITECTURAL ASSOCIATION DISCUSSION SECTION:

THE HISTORY, MANUFACTURE, TESTING, AND USES OF PORTLAND CEMENT.

THE fifth meeting of the session of the Discussion Section of the Architectural Association was held at 56, Great Marlborough-street, W., on the 20th inst., when a paper, prepared by Mr. H. Howard Humphreys, M.Inst.M.E. (unavoidably absent), was read by Mr. E. Stone Spencer, M.Sc., on "The History, Manufacture, Testing, and Uses of Portland Cement." The chair was occupied by Mr. R. H. Weymouth.

The Chairman said he would like to say how very much Mr. Humphreys regretted that he was unable to be present that night. About ten days ago he was called away on a business engagement to Spain, and he felt he was not justified in putting off an important business engagement, and had, therefore, asked their friend, Mr. Stone Spencer, to take his place. Mr. Spencer had known Mr. Humphreys for many years, and some part of his time worked under him. He was sure they would be glad to have Mr Spencer with them, when he told them he had made a long journey from Liverpool on purpose to read the paper.

Mr. Spencer then read the following paper:—The subject upon which I have the honour of addressing you to-night is one which, although at first sight it appears to be essentially dry, is in reality teeming with interest. Several years ago, when I first began to take special interest in Portland cement, the manager of a large works on the Thames made a remark which I, at the time, thought somewhat extravagant. He said, in effect, that in undertaking the study of this substance, I was embarking upon a study for a lifetime; after a good many years of research, I have, however, come to the conclusion that the remark was entirely justifiable. Cements all seem to possess an individuality which is marked to a far greater extent than is that of any other building material; different samples of this substance which only present what are apparently minute chemical and physical differences, will still act in ways which are often entirely contradictory.

The deep debt which we owe to Portland cement is hardly recognised as widely as it should be. Its invention alone rendered possible many of the extraordinary architectural, and more especially engineering, feats of the past century, and, when properly prepared, its durability far exceeds that of many bricks and building stones. Its present excellence is the outcome of years of patient scientific investigation, and although the names of its inventors and perfecters (who laboured principally during the first half of the nineteenth century) are forgotten, or at best but dimly remembered, the result of their work has revolutionised and assisted design to as great—or, perhaps, greater—an extent than has the introduction of mild steel for constructional purposes.

History.—Generations of constructionists, even before the time of Vitruvius, the celebrated architect for Augustus, had noted with dissatisfaction the difficulty of carrying out hydraulic works, owing to the lack of cementitious material which would set hard under water. Vitruvius himself says that after having laid the cofferdams for bridge foundations, "they kept the same empty for a period of not less than two months, in order to allow the masonry to harden."* We must not infer from this, however, that the Romans did not know something of the composition of hydraulic limes, for such a theory would be entirely contrary to fact; it has been found, for instance, upon examination of many of their mortars, that they recognised the advantages to be obtained by the mixture in their mortars of a certain amount of powdered brick or tile dust or a volcanic substance known as puzzolana. On the other hand, I do not think that we have much to learn from the Romans with respect to the composition of mortars. Vicat said that there was a belief throughout France that the Romans possessed a secret for the fabrication, and I have frequently heard remarks which have shown that a similar idea exists in this country. Analyses, however, of various ancient mortars prove that they possessed a variable composition, which would hardly be the case had a general specification (evolved from a special knowledge) been worked to.

Pliny at a later date (lib. 36) ruthlessly destroys the theory of general excellence of Roman mortars, for he says:—"The greatest cause of the ruins of the town was due to the fact that the cements were fraudulently composed of lime lacking in adhesiveness."† Evidently the building inspectors of Rome had troubles, and it is certain that whatever crimes may be urged against the genus jerry builder, it cannot be said that the race is of mushroom growth, although in this behalf we may even go back to an earlier period, as it is fairly evident from Biblical records that the labours of Joshua and his compatriots were considerably lightened in the case of the collapse of the walls of Jericho, by the circumstantial evidence existing that these structures had been erected by the progenitors of the gentlemen so much in evidence in the suburbs of London.

Throughout the Middle Ages the search for some more durable binding material continued; hydraulic limes were used, and to some extent understood, but the economic difficulties of transit prevented their general adoption, and it was not until the latter half of the eighteenth and the first decade of the nineteenth centuries that real progress was made. As usual, it was a case of necessity proving to be the mother of invention. Smeaton's research work, whilst he was building the Eddystone lighthouse, convinced him that the theories of the ancients were incorrect, and that lime burnt from hard stone did not of necessity give the hardest mortar. He noted also the important fact that many impure limes, which contained a fair amount of clay made an excellent hydraulic cement. Prior to his day it had not been generally recognised that it was an advantage to calcine clay and lime together, and so benefit from the partial chemical combination effected. Smeaton, however, did not turn his knowledge to financial account, and it remained for James Parker,* of Christ Church, in the county of Surrey, to invent and patent a cement in 1796, to which some years afterwards he applied the unfortunate misnomer of "Roman," giving rise to the theory that this material was originally prepared by the invaders of Britain. The deposits from which Roman cement was made varied widely in their composition, the resultant cements differing considerably. After the lapse of a few years Parker began to prepare his material from pebbles found on the Isle of Sheppy, Whitstable, and Harwich. At the same time the name was altered to "Parker's Cement," which was the immediate precursor of the material now so well known.

In the year 1813, Joseph Aspdin, a Leeds bricklayer, succeeded in manufacturing cement from limestone which had been reduced to puddle or powder and clay. He patented this in 1824, and called the substance "Portland Cement," because of its fancied resemblance to Portland stone.† In the year 1825, Aspdin established a manufactory at Wakefield for his cement, and in 1828 Sir Marc Isambard Brunel and his son, Mr. Isambard Kingdom Brunel, are said to have used this material on the Thames Tunnel. Aspdin's cement, after it had been fired, was only in a semi-burnt condition, proper vitrification had not taken place, or if it had taken place, those portions of clinker which approximated to blackness were thrown aside and considered inert, whereas in reality the best material was rejected.

It was, I think, General Pasley who, at a later date, discovered first the value of burning lime and clay to a point of incipient vitrification. James Frost, builder, of Finchley, should also be mentioned as one of the pioneers of the industry, as he in 1825 established himself in cement works at Swanscombe, the site, I believe, being the same as that now used by Messrs. Bazley White & Co. In the year 1830, General Pasley, then Inspector to the Royal Engineers School at Chatham, independently produced a fair hydraulic cement from the Medway clay and chalk, and he appears to have continued his researches for some time. He mentions, in the second edition of his book on the subject (1847), that there were three manufacturers of artificial cements in England who turned out satisfactory materials—Messrs. J. B. White, Swanscombe, Kent (who had taken over Frost's works at that date); Messrs. Evans & Nicholson, of Manchester, who were manufacturing what they called a patent lithic cement; and Richard Greaves, of Stratford-on-Avon, who was preparing blue lias cement. It is fairly certain, however, that General Pasley underestimated the number of manufacturers, Aspdin's Wakefield factory being amongst those omitted.

In the year 1843, Messrs. Grissel & Peto, contractors for the Houses of Parliament, conducted a series of comparative tests between Roman and Portland cements, consisting of

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* Relinquatur pila ne minus quam duos menses ut siccescat.

† Ruinarum urbis ea maxima causa quod furto calcis ferrumine suo cæmente componentur.

* Parker's patent provided for the preparation of cement from septaria or nodules present in clay. See Appendix for analysis.

† Aspdin's specification, No. 5,022, is dated October 21, 1824, and is for "An Improvement in the Modes of Producing Artificial Stone," which invention he thus describes:—"My method of making a cement or artificial stone for stuccoing buildings, water works, cisterns, or any other purpose to which it may be applicable (and which I call Portland cement), is as follows:—I take a specific quantity of limestone, such as that generally used for making or repairing roads, after it is reduced to a puddle or powder; but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself, and I cause the puddle or powder, or the limestone, as the case may be, to be calcined. I then take a specific quantity of argillaceous earth or clay and mix them with water to a state approaching impalpability, either by manuel (*sic*) labour or machinery. After this proceeding I put the above mixture into a slip pan for evaporation, either by the heat of the sun or by submitting it to the action of fire or steam conveyed in flues or pipes under or near the pan, until the water is entirely evaporated. Then I break the said mixture into suitable lumps and calcine them in a furnace similar to a limekiln till the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beat, or rolled to a fine powder, and is then in a fit state for making cement or artificial stone. This powder is to be mixed with a sufficient quantity of water to bring it into the consistency of mortar, and thus applied to the purposes wanted."—Redgrave's "Calcareous Cements."

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the breaking weights borne by brick beams and cantilevers. Their letter to the manufacturers states that they were satisfied that a mortar composed of sand in the proportion of three parts to one of Portland cement was more than double the strength of the Roman mortar, although the latter had only one part of sand. Messrs. Grissel & Peto's experiments advertised the material, and as they used it extensively on the numberless and extensive works of an architectural and engineering nature upon which they were engaged, the demand steadily rose. In the years of the railway mania, 1846-50, prices ran up for all hydraulic cements, so much so, in fact, that Sir Robert Peel, fearing exhaustion of septaria, proposed putting a tax upon it; but Mr. Aspdin interviewed Sir Robert, assuring him that even if the supply of the Harwich stones failed (from which the Roman cement was manufactured), there was a better material on the market, and one which was inexhaustible.

Experiments as to the crushing weights which could be borne by the two rival materials were conducted at Messrs. Bramah's works in 1848, and reported in the *Builder* of September 30 of that year, the results showing most conclusively the superiority of Portland cement.

In the year of the Great Exhibition (1851), experiments for tensile strength were made at that building, and this is the more interesting because it was here that briquettes first appeared. In 1859 the main drainage of London was about to be carried out, and the Board of Works were fortunate in selecting as their engineer Mr. John Grant, M.Inst.C.E., who was the first to take testing in hand in a systematic and scientific manner. His researches were brought before the Institution of Civil Engineers, and attracted so much notice that Roman cement soon became little more than a memory. The discussion on Mr. Grant's various papers not only had the effect of further popularising Portland cement, but immensely improved its manufacture, owing to the free interchange of thought between engineers and manufacturers.

Manufacture.—Present-day Portland cements vary considerably from those prepared under Aspdin's specification, which neither provided for a definite proportion between the limestone and argillaceous matter, nor for the burning of the mechanical mixture to a condition in which true chemical combination had taken place. It is in the careful observance of these two points, however, that one of the principal secrets of excellence in our present cements is found.

There are three principal methods of manufacture, viz.:—

1. Wet process.
2. Semi-dry or Goreham process.
3. Dry process.
4. Rotary process.

1. In the wet process, which is in vogue at some of the Thames and Medway works, chalk and clay are mixed together in definite proportions in a wash-mill, and with an excess of water. The mill consists of a round pit in which there are horizontal revolving arms fitted with vertical "tynes" or teeth by which the chalk and the clay are broken up and their particles reduced to a fine state of division. The resultant mixture called slip or slurry is then elevated to settling reservoirs, where the supernatant water is drawn off, or to drying chambers on top of the kilns, where waste gases from the flues absorb the excess of water. When the slip has been partially dried, it is chopped out in rough blocks, laid in kilns with layers of coke, the latter material being in the proportion of 8 or 9 cwts. to every ton of clinker produced.* The amount of fire required depends very largely, of course, on the quantity of moisture retained in the slip when kilned. There are almost numberless, and most ingenious, varieties of kilns, having for their object the utilisation of as great a proportion as possible of the waste gases from the burning clinker.

The changes effected in the kilns are various, but the main alteration is due to the liberation of the carbonic dioxide from the lime by the intense heat. The lime, deprived of this gas is in such a condition that it will readily enter into chemical combination with silica and alumina of the clay, forming silicates and aluminates of lime; it is upon the correct formation of these chemical compounds that the subsequent success of a cement depends. When the kiln charge has been burnt through, it is drawn, and (in the better class works) the unburnt portions of the slip are picked out by hand for recalcination. The properly formed clinker, which is almost black, but not glassy in appearance, is taken away to crushers, where it is reduced in size prior to being passed through the grinding mills. As in the case of the kilns, there is a very great variety in the design of these mills, but the mechanical details hardly appear to come within the scope of this paper. The final grinding of the cement should reduce the clinker to an exceedingly fine, almost impalpable flour, as other things being equal the commercial value of a cement will be in inverse proportion to the size of its grain. This point, however, I will elaborate later on. After leaving the mill the finished cement passes along a shoot or trough to the store, where it lies more or less exposed to the air until it is bagged up for delivery.

2. The Goreham or Semi-Dry Process is one in which only about one-quarter of the water required in the wet process is used in the wash-mill, but the mixture is further incorporated by passing the resultant slip between horizontal millstones or edge-runners. In my opinion, this system is vastly superior to the wet process, as (taking one point only) the heat required to develop power to work the millstones is nothing like so great as that required to reduce the excessive moisture in the slip prepared by the wet process. The subsequent grinding, &c., of the cement is practically the same as that already described under heading 1.

3. The Dry Process is used in some parts of Wales and in Warwickshire, where the interstratified limestone and shales of lias formation supply the materials for making cement. The raw materials are mixed in proportions varying according to their chemical composition; they are then crushed, ground to powder, mixed with water, and passed through a pair of wet stones, which incorporate the mixture as in the case of the Goreham process. They are then dried, loaded into kilns, burnt, and ground.

4. The Rotary Process of preparing cement* is not yet at work in this country, although it is largely used in the United States. In the first three processes described there are at least two serious drawbacks, due to waste of heat and to imperfect burning. The rotary process of manufacture was invented in this country by Mr. F. Ransome, and carried a stage further towards perfection by Mr. Wilfred Stokes. A difficulty, however, was met with which at the time seemed insurmountable, but the ingenuity of the Americans has overcome the obstacle, and now the process is a commercial success. Perfected machinery is being put in at the Swanscombe Works of Messrs. Bazley White & Co. The process consists in burning the slip in a slightly-inclined revolving cylinder, the feed being at the far end from the burner, which is supplied with injected coal-dust as fuel. The material slowly finds its way down the cylinder, and, at a distance of approximately 10 ft. from the burner, the sintering begins. When the clinker drops from the first cylinder it is said to be thoroughly vitrified, and entirely uniform in quality. The clinker then goes to a second inclined cylinder, where it heats the air passing to the coal-dust burner. After leaving the second cylinder the clinker passes through crushing rolls, which are sprayed with water, and which reduces the coarser lumps before the material passes into the third cylinder, where it is further cooled and pulverised prior to dropping into the trucks which take it to the grinding-mill. It is stated that the damping in the rolls has a beneficial effect upon the resultant cement, and that the material prepared by this process requires little subsequent aeration. The cost of production is said to be approximately three-fourths of that of the cheapest process in vogue on the River Thames and Medway and the output is very largely increased. The experiment will be watched in this country with great interest, but one may reasonably expect it will be a success, as Americans do not, in an ordinary way, take up a method of manufacture which will not give a good return on their initial expenditure.

Testing.—Amongst the materials of construction, cement occupies an unique position, as it arrives in the raw state—that is to say, it is unfit to go through the various processes of testing without further individual preparation, which is bound to introduce the personal equation to a greater or less extent. Moreover, there is a very wide divergence of opinion as to what the "further preparation" should consist of. In the early days of cement manufacture the tests were of a very rough and ready character. General Pasley's experiments were eminently practical, for he cemented bricks together and ascertained the tractive force required to draw them apart. Messrs. Grissel & Peto's tests, together with those of Messrs. Bramah and the ones made at the Great Exhibition in 1851, have already been mentioned. With the exception of Bramah's, they were all more or less crude, and it seems to have been left to Mr. Grant to make a further series of trials in 1866. One of these experiments was carried out with the object of ascertaining what the effect of shape of moulds was upon the tensile strength of briquettes. Mr. Grant tried ten different shaped moulds, and, after an interval of thirty days, he discovered that briquettes made from the same samples of cement, and under the same conditions, varied in the tensile stress they bore between 512 lbs. and 328 lbs. on the square inch, or in the proportion of 1 to 0·64, a result somewhat startling and quite sufficient to induce an attempt to obtain uniformity in the pattern of moulds. Makers of testing machines were soon in hot competition, and it was but natural that they introduced, not only what they considered improvements in machines, but improvements in the form of moulds. Comparison of tensile tests made by different experts in different shaped moulds became practically an impossibility on this ground alone. But the trouble in connexion with neat cement tests did not end with difference in the shape of moulds, and, in considering this point, it is necessary to have a clear conception of what are the real objects of cement testing. Amplifying Professor Unwin's conditions, I consider it essential (1) that a cement shall harden with reasonable rapidity under water; (2) That it shall remain constant in volume, except so far as unavoidable atmospheric changes cause expansion and contraction; and (3) That it shall develop considerable powers both of adhesion and cohesion. It is the duty of the expert to forecast the future condition of the cement he is testing. No. 1 does not require any very great experience to ascertain, but Nos. 2 and 3 present problems of considerable difficulty. The general tendency during the last twenty years has been in the direction of reducing the period of time allowed for the making of cement tests. This unfortunate hurry to make haste, coupled with the fact that architects and engineers have contemporaneously insisted on higher tensile results over the seven days' period, has caused considerable trouble, as it has often led makers to over-lime their cement, that is to say, to use this substance considerably in excess of that required to enter into proper chemical combination with the silica and alumina of the clay. By this means they have been able to procure a much higher seven days' breaking stress, but at the expense of the subsequent constancy of volume of the cement. I do not think that some users of cement have yet quite grasped how essential "constancy of volume" is, otherwise I am sure that far less stress would be laid upon tensile strength in specifications, and more attention would be given to the production of a material which would neither expand nor contract with the lapse of time. The seven days' tensile test (although it is a point which a large number of architects and engineers consider more than any other in an expert's report) is absolutely no guide *by itself* as to the future behaviour of a cement in work. This is true, even on the assumption that all experts made their tests in the same kinds of moulds under the same conditions of heat and cold, with equal proportions of water, and with the same degree of pressure in making the briquette. But the unreliability of this test is further increased by the fact that there is no general agreement upon public works (or amongst experts) as to the methods to be employed in manipulating the cement for tensile test. It is the easiest thing in the world for two different men to get a tensile result on a good cement varying anywhere between the limits of 350 lbs. and 600 lbs. per square inch in seven days. In a recent

* One ton of clinker roughly = 1½ tons of dry raw materials, which will be in the approximate ratio of 1⅛ tons of chalk to ⅜ ton of clay.

* Described in detail by Messrs. Stanger and Blount in a paper read before the Institution of Civil Engineers recently.

number of the *Contract Journal* I gave the following list of causes for divergent results :—

I.—*Due to Different Types of Machines and Moulds.*

A. The form and hanging of clips in which the briquette is held.
B. The distance of the point of application of the strain with reference to the minimum section of the stress.
C. The shape of briquette.

II.—*Due to the Cement itself.*

D. The age of the cement after grinding.
E. The fineness.

III.—*Due to the Operator and Testing-room.*

F. Amount of water used.
G. The temperature of water used for mixing and immersion.
H. The method of filling moulds.
I. The rate of mixing and trowelling.
J. The rate at which stress is applied to the briquette.

I have experimented upon the whole of these points, and have ascertained the variations as stated; but Mr. R. W. Leslie, of the American Society of Civil Engineers, goes much further than I do, as he says that there are no less than thirty-six causes having a distinct and definite influence upon the tensile strength. My modest list, however, will perhaps convince you that if you go to one expert, and he tells you that the sample of cement you have submitted to him only bears a stress of 350 lbs., and you then go to another expert who makes the breaking weight 500 lbs., you will have no common basis for forming a definite opinion as to the value of the cement, unless you also know precisely the conditions under which each expert carried out his experiments. I say, and say deliberately, that architects and engineers who trust to a seven days' tensile test alone, whether the briquettes are made by themselves or by experts, are living in a fool's paradise. To be able to place reliance on this test it should extend over a far longer period, and over such a period that, in the majority of cases, considerable inconvenience would be caused by delay in work. I give in the appendix the results of some experiments which I have made from very excellent cement supplied by Messrs. I. C. Johnson, of Greenhithe. The result of these tests shows that at the end of a period of seven days—

1. Briquettes made with hot—that is, unaërated—cement gave a considerably higher result than when the cement had been weathered and was in a condition for use.

2. That the effect of ramming the cement into the moulds increased the tensile strength by 136 lbs. on the square inch over that obtained by making the briquettes by thumb pressure only, which latter, I always maintain, is the correct method of making same.

3. That the flour of cement (*i.e.*, the most valuable portion) having been passed through a 30,000 mesh to the square inch sieve, and separated from the more coarsely ground particles, gave 145 lbs. less tensile strength than did the unsifted cement.

4. That the large section briquettes—that is, 1½ in. by 1½ in. (2¼ sq. in.)—did not attain nearly the same strength per square inch in seven days as did the 1 square inch sections.

The most startling and paradoxical of these results is that which shows that fineness of grinding reduces the neat tensile strength, whereas it immensely increases its covering capacity and adhesion to sand or other aggregate. If one were to judge by tensile test alone, it would be quite possible, and even probable, that a material high in cementitious value would be rejected in favour of one which contained possibly 6 cwts. per ton of improperly ground clinker, which has little, if any, more value than so much sand.

You will, I feel sure, forgive me if I have laboured this point somewhat, but several years of experience have taught me to place little, if any, reliance upon the neat short-time test. In conversation with the manager of one of the oldest and best works on the Thames recently, I found that he had come to precisely the same opinion as myself. If I appear to you to be playing the rôle of iconoclast, I feel that there is abundant reason for assuming this character. Far be it from me to say that the neat tensile test has no value. It has, if the time given by the architects and engineers is lengthened to one, two, or three months, but this is generally impossible in an age of feverish activity, and therefore we must look to other tests to ensure our obtaining a material which shall be safe. These tests are—1. Physical; 2. Chemical.

I.—*Physical.*

A. Constancy of volume.
B. Fineness of grinding.
C. Degree of aëration.
D. Specific gravity.

Dealing first, then, with constancy of volume, I hold that tests made with the object of discovering whether a cement has, concealed within itself, elements sufficient for its own subsequent disintegration are the most important that can be performed. You are all familiar with the "blowing" of cement work, and this is the way in which *inconstancy* of volume generally shows itself. There are a number of causes, some of which I need not trouble you with, but the one which occurs most frequently is due to an excess of free or loosely-combined lime in a cement. The fact that cements should be cooled by being brought into contact with air prior to use is widely known; the free or loosely-combined particles of lime which are present in every cement (however good) are slaked by this means, and their expansion takes place by the absorption of moisture from the air in very much the same way that ordinary lime is slaked by the addition of water. If a cement is slightly under-burnt and finely ground, the process of aëration is comparatively easy, but when a sample is hard-burnt and coarsely ground, the process is much more difficult, as the air will not reach the lime which is concealed, and which reposes in a metamorphic condition in the interior of the coarsely-ground particles. Obviously, then, the best way to provide against subsequent expansion is to have the substance ground as finely as possible, so that the air may play upon and hydrate the whole of the molecules. I have myself seen some remarkable instances of self-contained disruptive forces in a cement, destroying the stability of an entire structure. One instance occurs to me where a large railway viaduct, carrying four lines of way, and costing approximately 30,000*l.*, was badly damaged by the use of a cement which contained free lime, and which, after having been tested by the ordinary orthodox seven days' tensile test, had been passed as satisfactory.

In the case of concrete floors, the dangers are exceedingly great, as the floors are often practically monoliths without any room for expansion. I had some time since to report upon the disturbance of a building which, when erected, measured 16 ft. between walls. It had a concrete floor, which expanded and pushed the walls out 3 in. The invention of a clever little contrivance by the chief assistant of my Association (Mr. Harold Claxton) has enabled me to give you in the appendix one or two measurements as to the expansion of a hot, though excellent, material. All cements before use should be carefully shot into thin layers, turned over, and should not be put into work until the heat developed after mixing with 20 per cent. of its weight of water does not exceed 6 deg. in one hour. The whole of the tests carried out in the laboratory of the Association I represent are made under these conditions, and I am in thorough agreement with the system.

In regard to specific gravity, in many of the older specifications (and, unfortunately, in some of those still used), one finds that weight per "striked bushel" is retained; this is generally given at "not less than 112 lbs." Sometimes it is added that a cement shall be filled into the bushel measure from hopper spout 18 in. above the cement; but upon consideration it will, I think, be quite obvious that even under the last-named and best condition, a striked bushel is an exceedingly vague and thoroughly unscientific term. "Specific gravity" is fortunately rapidly taking the place of "weight per bushel" as a check upon burning, &c., and it is probably the best measure that we can have of density of the material; but if two tests for specific gravity are made upon the same cement which has undergone different periods of aëration, the results will not compare. Freshly-ground clinker will show a specific gravity of about 3·15, whereas after the hydration of the lime has been effected, and the cement is ready for use, I have frequently found that not more than 3·06 to 3·08 is obtainable. In comparing, therefore, the reports of two experts upon the same sample, it is also essential in this test to know the conditions as to heat when the experiments were carried out.

II. *Chemical.*—The chemical portion of a report will not by itself prove to be a sufficient guide as to the quality of the substance, but taken in conjunction with the physical tests it is almost invaluable, as it not only gives a check upon the physical report, but it renders possible the explanation of many points which otherwise would be difficult to interpret. It materially assists in detecting adulterations, and, if properly done, is a good guide as to the probabilities of a cement attaining great tensile strength with a lapse of time. The chief points to be looked for in the analysis are :—

1. Proportions of soluble silica and alumina to lime.
2. Proportion of magnesia.
3. Proportion of sulphuric acid.

As I have stated before, it is upon the proper chemical combination of silica and alumina with lime that the success of a Portland cement depends.

In an article in the *Builder* of October 5, 1901, I said that

"Dr. Spencer Newberry, after a considerable number of experiments, found that the limits of the molecules of lime to those of the soluble silica in the clay is as 3 to 1, and in the same way the proportion of lime to alumina should not exceed 2 to 1. Substituting atomic weight for these proportions, this will represent in weight 2·8 parts of lime to combine with 1 part of silica and 1·1 of lime to combine with 1 part of alumina Supposing that these proportions are departed from to an appreciable extent, it will then be seen that the best compounds, namely, a tri-silicate and bi-aluminate, will not be obtained, as there will either be a surplus of imperfectly combined lime present in the cement, or silica and alumina will be in excess."

Magnesia is hardly ever present to a harmful extent in Thames or Medway cements, but it occasionally appears to bulk large in the material made in the Midlands. Its action is subtle, and the last word has by no means yet been said upon its effects. It is generally thought, however—and there is, I think, good ground for this belief—that if present in proportions exceeding 3 per cent., magnesia may cause expansion after the lapse of a considerable time. I myself put the safe proportion at a considerably lower figure than 3 per cent.

The sulphur compounds are principally derived from coke. Sulphur compounds used for the purposes of burning the slip, and the amounts obtained from this source are not likely to have any very serious effects. Of late years, owing to the demand for finer grinding and the consequent necessity for otherwise giving a cement greater time to weather, it has been the custom to add small amounts of sulphate of lime, or as it is more generally known, gypsum, to the fresh cement; curiously enough, this compound has the property of somewhat retarding the setting. I have carried out several experiments, but have not yet arrived at a definite conclusion with regard to the ultimate effects of the sulphate. In the meantime, however, when asked for an opinion I invariably advise the exclusion of gypsum, as I consider that the same results can be obtained if a little extra time and care be given to aëration, and this latter course is, at least, absolutely safe. I have found that 2 per cent. of gypsum will certainly not be a sufficient quantity to so retard the setting of the finely-ground cements as to do away with all necessity for subsequent aëration. I have further found that upon supplementing the work of the gypsum by spreading out the cement and aërating it, the effect of the gypsum, as a retardiug influence, rapidly disappears. You may ask now what course I should suggest in testing a cement over a period of seven days. First and foremost, I place great confidence in the Michaelis boiling test, which requires a mixture of neat cement to be made up with about 20 per cent. of water, set in damp air for twenty-four hours, and immersed in cold water raised to a boiling heat, and maintained at that temperature for three hours. I am fully aware that this test is severe, but for important works I do not think it is at all too stringent, and I have never once known a case of failure in work where a pat had passed through the boiling ordeal without signs of radial cracking. If a cement is slightly coarse, this boiling test will find out and expand any free or loosely-combined lime which may exist within the larger particles, and I do not, therefore, think that anything short of this will suffice. Cements with low tensile strengths will not stand this test, and will frequently boil away entirely. The fineness of grinding should, I think, always be ascertained, but I

consider that fineness on sieves having fewer than 5,600 divisions to a square inch can very well be omitted. I do not believe that the portions of a cement which are retained on a 14,400 mesh sieve are of any great cementitious value, and the only reason which leads me to recommend the retention of the 5,600 sifting is so that if the rejected particles upon this sieve are very large in size, the severity of the Michaelis test may be increased in order thoroughly to penetrate the larger pieces of clinker. With reference to the tensile test, I should much prefer to substitute for the neat test a test upon standard sand. I have already explained that *adhesion and cohesion are not interchangeable terms*, and that the mere fact that a cement has a high neat tensile strength is not sufficient to prove that it will develop a great power of adhesion to foreign substances; but it is the power of adhesion that one really wants to test. It may be urged, on the other hand, that in testing with standard, or Leighton Buzzard sand, one is not obtaining a measure of the strength of one's mortar if such standard sand is not used upon the actual work for which the tests are made. This is undoubtedly true, but the neat test does not give any advantages in this direction, and by employing the sand test the possibility of rejecting a finely-ground material with a low neat strength in favour of a coarser cement would be eliminated. I give in the appendix a type specification which I hope may be of some service to members of this Association. It is, of course, prepared for high-class work only, on the assumption that architects are drawing their specifications with the main object of providing thoroughly durable work for their clients.

The Using of Portland Cement.

Under the heading of "Testing," I have laid great stress upon the necessity for properly aërating this material, but I think I should here add a word of caution with reference to exposing cements for too long periods prior to use. If there is any feeling of hard knobs in a bin of cement, the same should be carefully screened out, as so much moisture has then been absorbed from the air that chemical action has commenced, and this when once started prevents the nodules (even though reduced to powder) from setting a second time. Under some circumstances, notably in carrying out tide work, it is necessary to use a fairly rapidly setting cement. In putting in pier foundations some years ago, I succeeded in obtaining quick setting by other and, I think, safer means. The whole of the cement was first thoroughly aërated, and a small quantity of furnace ash was mixed in with the stone aggregate; the whole of the concrete was then mixed with fresh water through which a steam hose had played for a few minutes. The surface of the concrete was subsequently protected by ordinary sacking weighted down with iron joists or rails. By these means I was able to obtain a thoroughly sound, homogeneous, and quick-setting concrete; but there are circumstances where it is impossible to carry out this method, and consequently moderately quick-setting cements must be used in order to prevent the washing away of the concrete surfaces. In tide work fresh water should always be used for mixing in preference to salt, as, although salt water does not affect the strength of the material in the long run, it materially retards the immediate setting. For ordinary work in foundations or where hydraulic properties are essential, a slow setting cement gives the best ultimate results.

Aggregates.—First, for concrete. The most suitable aggregates for concrete are (A) hard broken stone mixed with sufficient clean, sharp sand to completely fill the voids (roughly about 40 per cent. of the total volume), or mixtures of broken stone, thoroughly vitrified furnace clinker and sand; (B) gravel with sand and hard broken bricks; (C) gravel and sand.

The advantages of broken stone over rounded material must be fairly obvious. Broken stone is generally clean, having jagged fractures forming an excellent key for the cement, and the volume of the interstices to be filled with sand and small stones is less than in the case with gravel. The addition of furnace clinker adds considerable toughness, providing it is thoroughly burnt and free from small dust. Granite is sometimes used, but more frequently various kinds of hard limestone. I always consider that the finest specimen of concrete that I have ever seen was made from the Kiama blue stone and estuary sand of the river Hawkesbury, in New South Wales. This concrete was used for the piers of the bridge spanning the river at Peat's Ferry. These piers below high water line were practically monoliths, the smallest of them measuring approximately 100 ft. in height, whilst the deepest was 160 ft. The concrete set so hard that it was practically impenetrable, and no sign of weathering has, to the best of my belief, ever occurred. Round stone, that has been water-worn, is not a good material, especially where the concrete has to bear transverse strains. If gravel *must* be used, I always consider that it is a great advantage to use hard broken brick (preferably well-burnt stocks or broken burrs) in conjunction with the gravel, as a certain amount of cohesion is thereby added to the mass which would otherwise be entirely lacking. Burnt ballast concrete is to my mind the worst of any; it is impossible to obtain a thoroughly vitrified class of ballast until the cores of the ballast heaps are reached. The outsides are entirely unsuitable for use in damp positions, as the baked clay is readily acted upon by the moisture, and gradually returns once more to its original condition. In making concrete too much attention cannot be given to the careful mixing of the cement and aggregates. I think that the fewest possible number of times of turning is four—that is to say, the material should be incorporated, twice dried and twice wet, the water being added through the rose of a water-can, so that the cement may not be washed off the stone; no water should, in my opinion, be added on the fourth turning. There has been much discussion as to the advantage or otherwise of dropping concrete into foundation pits from a considerable height. I am entirely opposed to this course, as I have noticed again and again that in course of falling the lighter and finer particles are left behind owing to greater proportionate atmospheric resistance, and the larger stone descends through the partially-set substrata disturbing chemical action and forcing the lighter portions to the top, causing lines of weakness. I do not think such concrete is ever thoroughly homogeneous. What is true of dropping concrete into deep foundation pits in the dry is even more true in the case of placing the material in water, as the evil of buoying up the lighter particles is accentuated in the case of passage through liquids, and I remember that in constructing the foundations for the bridge I have before mentioned we lowered every yard of concrete in an automatic opening hopper. Ramming has, to some extent, the same action as dumping from a height, and is by no manner of means an unmixed blessing, although it is claimed by some that it is absolutely essential if a concrete is to be made water-tight. I demur entirely to this view, as I believe that by the careful proportioning of the materials a water-tight concrete can be obtained without ramming.

Coming to the question of cement mortars, the same general principle which obtains in the case of concretes applies here also; that is to say, the cleaner and more angular the aggregate, the better will be the resultant compo. Sand should not have the whole of its particles of one size; there should be a small percentage of the finer granulations so that the volume of the interstices may be thoroughly filled. Remarkably good results can be obtained from hard furnace clinker ground in a mortar-mill by itself, and subsequently mixed with the cement. One of the great practical difficulties which is met with upon public works is getting bricklayers or concreters to mix materials in small quantities just sufficient for immediate use. If large volumes are mixed at one time they can only be prevented from setting by the addition of excessive quantities of water, and this will have a most harmful effect upon the cement work for all time, as proper crystallisation will never take place. If small quantities are used and mixed with just enough water to make them plastic and workable, a first-class compo is obtained. It should be remembered that chemical action begins with a cement as soon as water is added, and I am not of opinion that this action is delayed by the addition of sand or other aggregate. It follows, therefore, that cement concrete or mortar which has partially set should be thrown upon one side. There are two other points which require care; these are the protection of cement work from frost, and from sun and wind when initial setting is in progress. I believe that as bad effects are caused by the sun as by frost; the latter expands the materials, and so disintegrates them, and the former robs the mixture of the water requisite for crystallisation. Work carried out under conditions of extreme cold should be protected by sacking, and the water used should be warm; or if the work is in the nature of paving, an inch of sand spread over the surface will effectually prevent any but excessive frosts from disturbing the concrete. In the case of heat, it is a great advantage to keep the face of work watered and to cover it up with damp sacking. A further danger exists in using bricks which effloresce to a considerable extent, as a film of dust is formed on the beds which prevents thorough adhesion. I know of at least one disastrous failure due to this cause.

The use of concrete in connexion with expanded metal or with iron or steel rods has, I believe, a great future before it, as the additional strength obtained by the introduction of the metal is vastly in excess of what mere theory would lead us to expect. In Germany and France and in the United States this class of work is frequently met with, but up to the present time no very large amount has been carried out in this somewhat conservative country. It is bound to come, however, and, considering the condition of what is generally called the "skilled" labour market, it will be well if some substance (which it is possible to make by unskilled labour) can be substituted for brickwork, as we may then hear that bricklayers are once more pleased to lay more than 400 or 500 bricks per diem. There may be a drawback, however, in using this armoured concrete, for unless the iron or steel rods, joists, &c., are thoroughly protected, they will rust with great rapidity, and not only will their own strength rapidly disappear, but in addition to this the expansion of the metal in process of oxidation will cause disruptive forces to be set up in the heart of the work. I recently examined a concrete and rolled iron joist roof, the whole of which was protected by cement rendering; portions of the rendering had perished, but even in places where the concrete was absolutely watertight, the joists had rusted to such an extent in eight years, that upon calculation I found that the flanges were exactly half of their original scantling, and, to make matters worse, the oxidation was most marked upon the flanges and not upon the web, where the waste could have occurred with fewest bad results. I am certain that unless proper protection is given to the steel parts of many of the buildings which are now being erected, there will be trouble in the near future, owing to the causes which I have mentioned. Personal experience has led me to the conclusion that the best coating material which can be used on iron or steel is a mixture similar to Dr. Angus Smith's solution, but containing pitch and a certain amount of sand. This mixture, if applied hot, forms a tough, intensely adhesive skin which will stand a reasonable amount of knocking about. Joists look better painted, but I hardly think that appearances should be studied in matters of this kind.

In conclusion, I would draw your attention to a few results obtained by colouring samples of cement with a small percentage of lamp-black, red oxide, and ultramarine, as you may at some time find it advantageous to incorporate colouring matter with the cement. Should you, however, decide to apply paint to cement work, I believe that one of the best preliminary preparations is a solution of 1 part of good sulphuric acid in 100 parts of water freely applied to the surface of the work after the same has thoroughly set.

I must apologise for the abnormal length of this paper. The only excuse that I can offer is that the subject is one of intense interest to me and of immense and growing importance to those who are engaged upon constructional works. I trust, therefore, that I have not wearied you, and that you may not feel like the old Scotch lady who was seen hurrying away somewhat early from church, and who, on being asked whether the clergyman had finished his sermon, replied, "He's dune lang syne, but he winna' stop!"

Appendix I.

Analyses of Septaria used for making Parker's or Roman cement. Authority, R.E. Lectures, Chatham:—

Silicic Acid	12·0
Potash	Trace

Lime	35·0
Alumina	9·0
Peroxide of Iron	3·4
Carbonic Acid	29·0
Magnesia	1·5
Water	10 0
	99·9

Warwickshire raw material. Authority, D. B. Butler, A.M.Inst.C.E, "Portland Cement." p. 21 :—

Lias Stone.		*Lias Shale.*	
Silica	8·73	Organic Matter	3 72
Alumina & Oxide of Iron	8·78	Silica	30·05
Lime	43·95	Alumina	10 70
Magnesia	1·87	Oxide of Iron	3·30
Sulphuric Acid	·74	Lime	26·80
Alkalies	Trace.	Magnesia	3·68
Carbonic Acid	36·20	Sulphuric Acid	1·43
	100·27	Carbonic Acid	20·08
		Potash	·19
		Soda	·13
			100·08

Medway Mud from Gillingham. Authority. C. Spackman, F.C.S. :—

Silica	38·413	As sand in an extremely fine state of division.
Alumina with trace of Iron	1·856	
Silica	25·249	As hydrated silicates.
Alumina	14·244	
Ferric Oxide	6·744	
Lime	·810	
Magnesia	1·727	
Potash	2·957	
Soda	·773	
Water	3 384	
Iron Pyrites	·214	

Medway Chalk.—This substance commonly contains 92-94 per cent. of pure carbonate of lime, with very small amounts of silica and alumina.

Analysis of Messrs. I. C. Johnston's cement used for experimental purposes in connexion with this paper :—

Moisture	0·37
Alumina	7·35
Insoluble Matter	2 37
Combined Water and Organic Matter	0 95
Ferric Oxide	3·47
Sulphuric Acid	1·25
Magnesia	0 99
Carbonic Dioxide	0·93
Lime	60 39
Soluble Silica	21·41
Undetermined	0·52
	100·00

Expansion of New Cement. — A first-class cement, mixed with 20 per cent. water, expanded on mixing $\frac{1}{8}$ in. per 100 in. in one day and $\frac{1}{4}$ in. per 100 in. in seven days, or at the rate of 1 in. in 33 ft. 4 in.

Appendix II.

EXPERIMENTS SHOWING UNRELIABILITY OF SHORT TIME TENSILE TESTS ALONE.

The effect of making briquettes with hot cement—

	Average ultimate tensile stress in lbs. per square inch after 7 days.
Briquettes made with cement of maximum rise of temperature of 14 deg. Fahr.	473
Briquettes made with same cement cooled to 6 deg. Fahr.	449

The effect of ramming cement in moulds—

Briquettes made by ramming cement in moulds	586
Briquettes made by pressing cement into moulds with thumbs in usual way adopted by Cement Users' Testing Association	450

The effect of fineness of grinding—

Briquettes made with unsifted cement (residue on 14,400 mesh = 14·84 per cent.)	449
Briquettes made with same cement after it was passed through 30,000 mesh sieve	304
Briquettes made with residues left on 14,400 sieve	50

The effect of various sectional areas—

	Per 7 days.
Briquettes of $2\frac{1}{4}$ square inches cross section	306
Briquettes of 1 square inch cross section	448

Appendix III.

SAND TESTS.

For these experiments the sands used were passed through a 20-mesh sieve and retained on a 30 mesh. Ten per cent of water. Sand to cement as 2 to 1 :—

	Ultimate tensile stress after two months. lbs. per sq. in. Unwashed.	Washed.
Sand from Newbury	430·2	430·2
Sand from Nuneaton	265	320
Sea sand	307	308
Furnace clinker	320	325
Standard Sand	267	261
Granite dust from Rugby	361	356
Granite dust from Nuneaton	350	351

Effect of partial setting of cement mortar prior to use. Briquettes made with cement, and standard sand and cement, as 2 to 1 :—

	Ultimate tensile stress after two months.
Mixed one hour before putting into moulds	83
Put into moulds at once	220

The effect of colouring matters. Briquettes made with cement and standard sand 2 to 1 :—

	Ultimate tensile stress after two months. lbs. per sq. in.
Coloured with 5 per cent. ultramarine	304·5
Coloured with 7·5 per cent. oxide of iron	325
Coloured with 4 per cent. lamp black	286·5
Uncoloured cement mortar	270

Appendix IV.

TYPE SPECIFICATION FOR IMPORTANT WORKS.

Fineness of Grinding.—The cement shall be prepared from thoroughly burnt clinker only, without any admixture of under-burnt portions or other substances. Not more than 5 per cent. residue shall remain on a sieve of 5,600 meshes, and 12 per cent. on a sieve of 14,400 meshes to the square inch.

Specific Gravity.—The cement when freshly burnt shall have a specific gravity of not less than 3·15 or 3·08 when weathered to 6 deg.

Chemical Analysis.—A sample shall not contain more than $1\frac{1}{4}$ per cent. magnesia, $1\frac{1}{4}$ per cent. sulphuric acid, 1 per cent. carbonic acid, or 1 per cent. insoluble residue, and shall not contain more than 62 per cent. nor less than 58 per cent. of lime.

Tensile Tests.—Test blocks of not less than 1 sq. in. cross section shall be made with 20 per cent. of water after the cement has been weathered, and the mixture shall be placed in a mould without ramming and kept one day in a moist atmosphere of a temperature not less than 50 deg. Fahr., and shall afterwards be placed in water of temperature not less than 55 deg. Fahr.

Some of the blocks shall be made of neat cement, and some of 1 part cement with 3 parts by weight of standard dry sand ; the latter shall have 10 per cent. of water only. The neat cement blocks shall bear a stress per square inch of 400 lbs. after seven days, 500 lbs. after fourteen days, and 600 lbs. after twenty-eight days.

The cement and sand blocks shall bear a stress per square inch of 100 lbs. after seven days, 150 lbs. after fourteen days, 200 lbs. after twenty-eight days.

Slabs or cakes shall be made with 20 per cent. of water and shall be kept in air for twenty-four hours ; afterwards they shall be immersed in cold water and raised to boiling heat, and maintained at this temperature for three hours. No signs of warping, checking, or radial cracking shall show on them.

A pat made with 20 per cent. water shall not take less than three hours to harden, and not more than seven hours.

All cement shall show a uniform growth of strength.

Adhesive Test.—A pat of cement 3 in. diameter and $\frac{1}{2}$ in. thick shall, after the expiration of seven days, adhere firmly to the natural surface of a Welsh slate ; the slate to be soaked in water prior to the application of the cement and to be kept moist during the interval.

Heating.—A sample of the cement shall be made into a paste, and if the rise of temperature be more than 6 deg. Fahr. during an hour after mixing, the cement shall not be considered ready for use nor for testing.

Expansion.—The cement shall be shot on to a perfectly dry floor in a watertight shed near the site of the works and to a depth not greater than 1 ft. ; it shall be permitted to remain as long as the architect shall direct, and shall be turned over from time to time as the architect shall direct.

The Chairman said he was sure they were very grateful to Mr. Spencer for reading the paper. They would have noted he hinted that experiments had been specially made for the meeting, and if Mr. Humphreys had been there they would no doubt have heard that for the last three months he had been making experiments so as to bring his paper as much as possible up to date. He thought they might take it that they had really got the latest information on the subject from one who was undoubtedly an expert.

Mr. Max Clarke said the first thing they had to do was to thank Mr. Humphreys for taking such an immense amount of trouble with his paper, and they also had to thank Mr. Spencer for reading it in the absence of Mr. Humphreys. He (the speaker) would only say that they had, he supposed, selected him to the martyrdom of opening that discussion just for the same reason that cement had taken it upon itself in the last two years or so to make a martyr of him. For about that period he had been building some very extensive buildings of one kind and another. He commenced by acquiring a cement-testing machine, and he made some experiments, and when he produced the result of those experiments to the cement manufacturers they laughed at him, and they said, "You should go to some proper man." So he (Mr. Max Clarke) went to a proper man, and he got a report in due course. But what appeared to him to be the great difficulty as regarded the work was that he was provided with cement which set, so his expert said, in five minutes. That had been going on for about three years, in which time he had sent tons away ; altogether, he should say, he had sent 350 tons of cement away absolutely, in barges containing 60 or 80 tons per barge. He had got rid of it because it was totally impossible for the bricklayer who set his 500 or 600 bricks a day to use it quick enough ; it would not be set. He was told by their expert and, of course, by Mr. Humphreys that he was to expose it to the air and to aërate it, but he thought they ought, if possible, to acquire some practical details, and he would suggest that when they were drawing a specification, not only should they put in it that they were to obtain the cement aërated, but also a stipulation that if it did not come in aërated the builder or contractor might take upon himself the aërating. He had 80 tons of cement come in to him last week, and he had a report one day this week, and for the first time he had compelled the builder to turn it out because it set in less than five minutes. He had the manufacturer up at his office, and he said, "It is a great pity you have not some of that cement here now." He (the speaker) replied, "Yes, I have ; here is the other half of that which I sent to the expert." It was produced, and the manufacturer set to work, and they had a pat of cement tested and that pat took about one hour and three-quarters to set. After he went away they had a little private experiment of their own in the office, adding a less proportion of water but still sufficient, and their cement had set hard a long time before that which was made up by the manufacturer. Those were the sort of difficulties they had got to contend with. He would have been pleased to have heard something about the aggregate which Mr. Humphreys would propose for floors. Of course, that was one of the great difficulties that any one who built largely in the factory way or anything in the public building way had to contend with. It had been more impressed upon him lately by seeing at a meeting the other day drawings of a large school building, and on the top there was a large playground with a brick parapet 7 ft. high. The brick parapet was cracked in many directions very considerably, and from the level of the first floor to the level of these playgrounds the walls were pushed outwards about $7\frac{1}{2}$ in., and in some portions of the school horizontal cracks had developed immediately under the concrete floor or roof. That might have been explained, perhaps, if it had occurred immediately after, or somewhat immediately after, the place was built ; but the cracks did not develop in the building either vertically or horizontally until more than a year after the school was finished. One or two items in the paper struck him as being, perhaps, the reason which would account for that peculiarity, but it was not a pleasant thing to know that a year after one had left a building, and received his commission, and gone away perfectly happy, that something might happen which might make things very unpleasant. He noticed that Mr. Humphreys recommended a mortar mill, but two or three sentences further on they were told not to mix up the cement in large quantities. There were two things about the mortar mill, and one was that it was the very worst invention that was ever produced for any man that wanted to do good work, because all sorts of things could go into it, and they were concealed in a very

rapid manner ; the second objection was that you could not manufacture properly a very small quantity of mortar in a mortar mill, and, therefore, it was very objectionable from that point of view. Therefore, if they took his advice they would not use a mortar mill in making mortar in which cement was used. There were two or three points upon which he did not seem to be quite clear, and first he would like to know whether he heard aright that cement was not delayed in setting by adding sand. It might be said that it was a difficult question for them to talk about, and that it was one for the experts ; but he looked at the matter from a different point of view. He wanted the best material which would stick his bricks together, and he certainly thought that when he added mortar to the cement he made it set slower. Another point he did not feel certain about was as to joists rusting when they were completely surrounded with Portland cement. He himself had taken iron joists which had been in concrete floors for more than ten years—and not only had he seen them taken out, but he had seen them put in — and they were just as good the day they were taken out as the day they were put in ; there was not one single particle of rust on them. He had always been under the impression that it was rather a disadvantage than otherwise to paint joists if they were to be completely embedded in concrete, but, of course, one had to see that they were completely embedded. Then he would like some information about the use of coke breeze. He had the unfortunate privilege of being one of the members who had got to do with the British Fire Prevention Committee, and they had definitely made up their minds that coke breeze concrete was the sort of concrete that would last in a fire better than any other. Some people said there were two sorts of coke breeze concrete—one was called pan breeze, and the other was called ordinary coke breeze. If anybody could give him any information as to the values of these two different sorts of coke breeze he would be obliged. In some cases sawdust was used to cover a concrete floor, and, of course, it was much cheaper to use sawdust than sand. In conclusion, Mr. Max Clarke said he felt sure they would heartily support the vote of thanks he had the pleasure of proposing.

Mr. George Smith, in seconding the vote of thanks, said that before one got up to discuss the paper one wanted some time to study it quietly, but there were one or two points which struck him on which he would rather like some information. One was the point raised by Mr. Max Clark about coke breeze. He knew himself from experience that there were two kinds of coke breeze—or rather coke breeze and clinker breeze, which was usually passed off as equal to coke breeze. However, one was worth 1s. a load compared with coke breeze at 4s. or 5s. He did not think from the fire-prevention point of view clinker breeze was a safe material to use. He would like to hear from Mr. Spencer or Mr. Butler some idea of what would be a good proportion of cement and coke breeze for a floor. As regarded the question of steel joists rusting, to which Mr. Max Clarke had referred, he should say that if they adopted the usual limit of encasing their steel joists with 2 in. of concrete all round there would not be much danger of rusting. He recollected about some ten years ago a friend of his constructed a very large paper mill, in which a large quantity of iron joists and concrete were used, and almost as soon as it was finished there was a large crack right down the building, which they discovered was due to expansion of the concrete, and about that time he saw it stated in one of the professional journals that the rate of expansion was something like $\frac{1}{8}$ in. in 96 in., or something like that. He would like to know whether there was any reliable amount of expansion to be allowed for. Of course, in the floor to which he had referred, the usual deal fillets had not been provided — it was rather before they were thought of. With regard to the question of testing cement, he thought that to a very great extent for ordinary buildings they did not require cement to undergo such a severe test as was generally specified. Certainly if they specified for tests at all he thought they ought to make certain that the tests were carried out. The usual practice seemed to be to adopt a test and then not to carry it out. That, he did not think, was fair play to either the builder or the employer. What he would like to have some information about was as to what was a fair test for ordinary building cement as distinct from engineering cement. Of course he quite recognised that for engineering they wanted the very best cement, but for building purposes he did not see that they needed such a very strong cement. He remembered that some years ago he had to test samples from each eight tons which were delivered. It was regularly passed, but one lot was condemned, and of course the manufacturer was very much upset about it. He came down and put some of the cement in a mould and the cement stood the test, but the amount of pressure which he put into his pat was very different to that which was applied in the others. After that it was discovered that the machine used had been out of gear for some time, and consequently the whole thing was an absolute failure. They wanted to make sure that if a cement was going to be tested, it was tested by a standard measure. There were so many machines about that he thought the tests ought to specify the machines to be used for them. He would say in conclusion that in his opinion the specific gravity test was the best they could possibly have, provided they had the requisite equality of time between the different samples.

Mr. H. Claxton at this point explained a number of photographs bearing on matters put forward by Mr. Humphreys.

Mr. H. Cartwright Reid said that cement of course was one of the most interesting subjects to an engineer, and he had listened to the paper that night with a good deal of pleasure. It did them all good to go back over what might be somewhat familiar ground, and it did them good to hear the latest on any subject, and they had had both that evening. There were, however, so many points in the paper he would like to say a word about that he hardly knew where to begin. He was one of the engineers of the Admiralty and they were continually day by day dealing with cement. They tested every load of cement they used, and it frequently happened that their rejections were by no means small, and it often happened that they were told when a rejection took place that if they had only known it was an Admiralty specification the cement would have come all right. That contained a moral, viz., that if they did not test they did not get what they specified. One of the speakers said he did not quite see that architects required a very high quality of cement, and he supposed that with the ordinary mortars for sticking bricks together there was no point in having such very good cement. Lime mortars had answered the purpose, and they saw that in many of their most prominent buildings lime mortars had answered all the purposes of the architect. He did not know whether it was the practice in London amongst contractors to specify cement mortars, and to what extent ; but for ordinary mortar it did not appear to him that architects gained very much by the use of cement. But in concrete, of course, they must use good quality cement, and when they were cutting floors down to the smallest dimensions so as to reduce the thickness, they must have the best quality cement. They had heard a good deal of very interesting matter as to the way tests might be manipulated, and he had had a good deal of experience, and had tested for thousands of tons of cement, or supervised such tests. He had often had the manufacturers' representatives, who had told them all sorts of things they wished done in order to bring about a proper result. One gentleman, from a large firm in the Medway, said he always liked to test his cement by the German method, and wished to have it encased in a glass case and at a uniform temperature, with so much moisture, and put on blotting paper. Well, as the cement which they were going to use was not to be put on blotting paper it did not appear to them that the test was going to be of very much good. One point not alluded to in the paper was that they ought always to have an average of samples. That was done by the Admiralty, and they found they never had two alike, but the average gave them an idea. To take one particular sample and test it was not very satisfactory. Then they had heard a good deal about the expansion of concrete and the expansion of cement. He had an example of that which rather took him back on one occasion. They were building the wall of a reservoir at Chatham 250 ft. long, about 16 ft. high, and 7 ft. thick at the bottom. It was built in the very hot summer about three years ago, when they had a sudden change from hot to cold weather, and the wall broke into segments at points about 30 ft. apart. They were very much perturbed and wondered if the foundations had given way, but it was noticed that on a very cold morning the cracks were a measurable quantity, and when the sun came out in the heat of the day they practically disappeared. They did not meet much guidance there to suggest a remedy, and when the temperature was low they filled the cracks in. They had also heard that night of the evils of the mortar-mill, and there was no doubt that a mortar-mill was not an unmixed blessing, and an example of that came to his knowledge which was of rather an amusing nature, in connexion with one of the Admiralty stations a good many miles from London. When they took a lease from the Chinese Government of Wei-hai-Wei there was a pier which had been built by some railway contractors some years before, and it was a pier of concrete piles surrounded by a wall, and on the top was a concrete floor which had been a good deal damaged during the Chinese and Japanese war. The Admiralty had the pleasure of putting the pier right, but in the interval between the war, the Chinese, being short of cement, took up the floor and ground it up to make fresh cement, as they could not get any other.

Mr. H. H. Statham said there were one or two points he would like elucidated. The writer of the paper had said there were three methods of manufacturing cement, and then he proceeded to mention four. He would like to know whether the rotary method was combined with one of the others. Another point sent a shudder through him. They had been told by every writer on cement that there was nothing like fine grinding, and that the more it was ground the more powerful it was. In the paper, however, they heard that finely-ground under certain circumstances was less effective than the coarse ground. He had been looking at the specimens, and one was marked "Cement of bad colour." He had looked at it with great interest, but in the first place he could not see any difference in colour between that and another one not condemned with that phrase. He did not think the difference was very marked. They would like to know what was the meaning of cement with "bad colour"—what bad quality it implied, and how they were to distinguish between cement of good colour and bad colour. There was a much larger point which had often exercised his mind, and that was as to the combination of iron with concrete. How far really did the iron and concrete act together? It seemed to him a very doubtful thing. When they put an iron joist into concrete, did they really act together in resisting forces?

A Member remarked that one thing occurred to him, which was the importance of seeing that the cement was not used hot and had been aërated. The manufacturers made it, and, of course, were anxious to get rid of it, and it went to the builders and merchants. They did not want to store it, for, of course, it meant money to them, and as soon as they had made it they wanted to get rid of it. That was an important thing for them to watch, and it was more important, perhaps, than the actual tensile strength. Some years ago Mr. Earl read a paper there on the manufacture of Portland cement, and it was mentioned then about not using cement when it was hot, and it impressed him very much, and it came in very useful to him because at that time he had to re-stucco a church, and it was most important that the cement work should not come cracking off very soon afterwards. Fortunately, he came to the discussion there and got the information from Mr. Faija and sent samples to him for testing, with the result that it was all right. He mentioned that because he felt that the use of fresh cement was the greatest danger they were likely to run into. He had listened with great interest to the paper, and was sorry Mr. Humphreys was not there himself, and he supported very heartily the vote of thanks.

Mr. L. Jacobs observed that Leighton Buzzard sand had been mentioned. He would like to know if anything had been ascertained about that, as a builder had told him there was a great deal of iron in Leighton Buzzard sand. Would that have any detrimental effect on Portland cement?

Mr. Arthur Harston said that he was glad to hear Mr. Humphrey advocated the necessity of different finenesses of sand. They wanted variations in the grains which cement would fill up. He quite agreed that from the architect's point of view, strength was no

necessarily the most important factor in cement. The absence of expansion and contraction seemed to him from their point of view much more important. He did not mean to say strength was unimportant, but he did not think it was desirable to have an exceedingly strong cement if it would conduce to a greater liability of expansion and contraction, and that is why he agreed with previous speakers that strength was not only the only thing to be considered by architects in judging their cement. He, like Mr. Statham, was somewhat surprised to hear the lecturer say that fineness reduced the tensile strength. He was in hopes that the new process which was to winnow the cement so as to give them all flour and no residue, was to give them a better cement, and that a cement free of residue would be less liable to expansion. He was in hopes that they would have got rid of the residue altogether, but now his hopes were somewhat shattered. Of course, an architect dealt with cement as only one of the many materials he used, and he could not test everything. Cement came in in cartloads, and one would be all right and the next all wrong. They would not specify it to be ground extra fine in the way that people whose living depended upon it would specify. He was told that paviors always paid extra price for it and they had it stored and seasoned in the cement works, and that this special cement when it was sent out had a little blue ribbon tied round the mouth of the bags. They had got into the habit of calling it the blue ribbon cement. Referring to an article in the *Builder* of October 15, he would like to know whether there was any information whether gypsum was being used more largely. He believed it had been said that the addition of gypsum was a comparatively recent innovation in the manufacture of cement—at all events within the last few years. There were alterations also taking place, one saw from the *Builder*, in the manufacture of gas, and he would like to know whether the altered gas process increased the sulphur in the residual coke, and whether it altered the coke so as to affect a coke-breeze when used in the aggregate—whether more or less sulphur was in the coke, and if so, whether it had a prejudicial effect when used as an aggregate. With regard to expansion he might say that when care was taken in the aëration of the cement they had had no serious difficulties, but he had heard lately of several cases of expansion. The splits, as far as he came across them, were not very serious, but still if a building split into various sections, no matter how small, it was not a nice thing, and it was very peculiar that those fractures had occurred in buildings in which coke breeze floors had been laid. Certainly they were rather long floors—120 ft. long—and they had been laid in all seasons and in all normal temperatures. The expansions, however, took place from six to eighteen months afterwards. It might have been considered that the expansion really took place earlier, but in this case it was not so, because the inside cement was put on a considerable time afterwards, and the inside cement had been painted and varnished and no cracks were observable until some time after that. So that it was evident, as far as his experience was concerned, it was some new kind of expansion he had not met with before. In a conversation with Mr. Spencer that evening and also from the remarks of several of the gentlemen who had joined in the discussion, he found that his experience was not unique. But in these cases, he should imagine, the cement was either unusually defective or had not been properly aërated. He would like to know whether the concrete expansion depended at all on the aggregates. For instance, would ballast concrete or coke breeze concrete be more liable to expansion? He himself thought that coke breeze concrete was not so liable to expansion, or that if it did it might expand in the vertical position, whereas ballast concrete would go the other way—that is, expand in the direction of length and not of thickness. He did not know how far that affected the question of breeze always containing sulphur. He had a case in which a hot-water pipe was laid in a pipe filled with coke breeze, and it rotted away in a very short time, and the explanation given was that there was sulphur in the coke breeze. Whether that caused the expansion in that particular case he did not know, but there was always sulphur in the breeze, and it appeared to him if sulphur lime compounds affected the cement to any great degree, then the sulphur in the breeze and the lime in the cement might be reasonably suspected of interacting on each other. In a publication which had been before them some time it was stated that pan breeze should be strictly prohibited, but an eminent architect who had had the conduct of many large buildings specified pan breeze and a certain amount of coke breeze. Ordinary breeze was that which fell through in the gas companies' works. But pan breeze was that coke which they used over again as fuel under their retorts, so that it got burnt again. Whether that affected it he really did not know, but the two authorities he had referred to quite differed as to which was the best. He was told on inquiry of a gas engineer that pan breeze was much cheaper, and that was why builders preferred to use it, he supposed. It contained little particles of iron from the furnace bars, and he should imagine it contained a good deal of ash. Then again, the stuff which was called clinker breeze was got from furnaces. He thought that was the worst of the three, as it contained a good deal of impurities—iron and so on. With regard to aëration, a builder told him some time ago that a builder would be a fool who did not aërate cement, because if they took the hot cement and aërated it they could make much more of it; but when the builder came to do the work, he (the speaker) found that he had considerable objection to aërating it. The question had been raised about the use of the mortar mill. As to iron joists rusting, it was quite a new experience to him. He had seen iron joists taken out all right, but personally he did not like them painted. With regard to that point sometimes pins were put in to give a hold and sometimes square rods were used and twisted—in fact anything to prevent the iron from slipping. It was a curious thing with regard to the addition of gypsum to cement that it delayed the setting of the cement, and that was a thing he did not know before the paper was written. If the cement was going to be good, he did not know what good was done by delaying the setting, and if it was going to set in five minutes they should not use it at all, and he did not think the addition of gypsum was any good in that case. There was one question he would like to ask. They had heard of the slaking of lime as it was done by the Romans. They used to put it in a pit for three years, and he would like to know what kind of lime that was. If they in England nowadays were to slake lime for three years in a pit, and it happened to be only a very slightly hydraulic lime—the stone lime used in London—what little hydraulic properties it had would go.

Mr. J. G. Walker remarked that it had been said that Portland cement should not be used hot, and should be turned over four times; but it had not been said what intervals should elapse before each turn-over. He might say that in drawing up a specification the other day they were not allowed to use Leighton Buzzard sand in the concrete, and a builder who came in said he knew from experience that Leighton Buzzard sand would not set under water. He said it was all right where the air had a certain amount of effect upon it, but it would not set under water.

Mr. D. Butler Butler (Special Visitor) said that there were so many points in the paper that he would hardly have time to deal with them all. One speaker had referred to four processes of cement manufacture, but he, Mr. Humphreys, was wrong in tabulating the rotary process as a fourth process. The rotary process simply referred to the calcining of the cement and nothing else. There was the amalgamation of the raw material, the chemical combination of the raw material into certain chemical constituents by heat, and the grinding of the clinker after it had been burned to a powder. So, really, the rotary process was hardly a process at all, and was only a third of the process. Then Mr. Humphreys made the statement "When the kiln charge has been burnt through it is drawn, and in the better class of works the unburnt portions of the slip are picked out by hand for recalcination." It was rather unfair to refer to that "better class of works," because from his experience he knew that nine-tenths of the works had a boy specially told off to pick out the unburnt portions. With regard to the point raised by a speaker as to the effect of the fine grinding of cement, he thought the speaker scarcely understood Mr. Humphreys' point when he said that fine grinding deteriorated the value of cement, because it was the reverse. Fine grinding might perhaps make a cement give a lower tensile strength when gauged neat, but when it was used with sand the fine grinding gave a much greater covering power, and therefore greatly increased its value. There was another point mentioned by Mr. Humphreys, viz., that in finely grinding the cement they also obviated the blowing or expansion, because the blowing or expansion was generally due to particles of free or uncombined lime contained within the unground particles of clinker, which was subsequently affected by water in the concrete. It had been proved by experience that if fine ground the tendency to blow was largely obviated. With regard to the specification on the tests Mr. Humphreys advocated, he divided them into three. These were all very well, but he did not think they were of any value unless they also had some idea of the strength of the cement. He was at issue with Mr. Humphreys as to the cooling of cement. He says, "A sample of cement shall be made into a paste, and if the rise in temperature be more than 6 deg. Fahr. during an hour after mixing, the cement shall not be considered ready for use nor for testing." He submitted that the evolution of heat during setting was entirely due to chemical action, and did not depend on the lime. The heat depended on the setting qualities of the cement, and nothing else, and, therefore, he did not understand the reference to 6 deg. Mr. Humphreys headed his specification for "important works," and he took it that the specification was a good deal too laboured for the ordinary small building work. It would cost too much, and it would be scarcely worth carrying out for small work, but for an important engineering work it was, of course, necessary. Mr. Humphreys spoke very highly of Johnson's cement. He knew that firm produced very good cement, but it was rather a peculiar thing that in the specification he alluded to 1 per cent. of insoluble residue, while in the analysis he gave to Messrs. Johnson there was 2·4 per cent. He did not attach any importance to that. Insoluble residue was supposed to indicate the amount of burning to which that cement had been subjected, but after all it was negligeable. With regard to tensile tests, Mr. Humphreys said in the specification that test blocks of not less than 1 sq. in. cross section shall be made with 20 per cent. of water, but he could not agree with any hard-and-fast line being laid down as to the amount of water to be used in gauging cements. Some required 24 or 25, and some 18 per cent. It was purely a matter of the requirements of the particular cement under examination. Then Mr. Humphreys said a pat made with 20 per cent. of water shall not take less than three hours to harden, and not more than seven hours. Did that mean three hours before the final setting? He supposed Mr. Humphreys took the final setting. Then they came to the heating business again, and as he said before, that entirely depended on the setting properties of the cement. Coming to tests, and as to the best tests of architects' general work, he would like to refer to his late chief, Mr. Faija. One of his dicta was that for ordinary work if the cement was sound—that was to say, had shown no expansion or contraction—and well ground, in nine cases out of ten it was good enough for all constructive purposes. That was a broad specification, but he gave it as enough for most cases of architectural work. Of course, in addition to that, they might have the ordinary tensile strength test, but the soundness was the chief thing. It stood to reason that if the cement was unsound, it was no good showing strength, and that was a point he always tried to impress. Here, again, he disagreed with Mr. Humphreys, for he thought his test of soundness was too severe. For ordinary purposes he thought the Faija test quite good enough, which was a pat allowed to set in a moist atmosphere for seven hours and then plunged in boiling water and remain for fourteen hours. He had always found that reliable, both from a manufacturer's and user's point of view. He had had a good many years' experience as a maker of cement, and knew something about it. He thought that Mr. Humphrey's test should be used in a negative sense only. He meant that if the cement stood the boiling they could be quite sure they were safe; but not to say because it would not stand the boiling it was not safe. The point had been raised of the iron and concrete, and he understood that the cohesion of cement concrete to iron was equal to 550 lbs. per square inch. He could not say that he agreed with painting

the joists, for it seemed to him that would destroy the cohesion. The reference to hot cements was somewhat of a misnomer. They could not call it hot, but he could describe it as a cement not fit to use. As to special storing and grinding for paving purposes, of course, if those who made a speciality of paving liked to pay the manufacturers a special price for fine grinding and special storing they might do so, but they could hardly expect the manufacturer in the ordinary way to grind cement extraordinarily fine and store it for nothing. The finer it was ground the more it cost.

Mr. Harston said his point was that the men brought the cement tied with blue ribbon and it was considered that was special for paving.

Mr. Max Clarke said in the previous specification it was left very vague.

Mr. Butler said a good deal of controversy had raged round the use of gypsum making cement slower setting. They all knew that gypsum had been accepted on the Continent for many years past within 2 per cent., but he was at one with Mr. Humphreys when he said he did not think the matter had been sufficiently threshed out yet to admit the use of gypsum without question. As to aeration increasing the bulk of cement, particulars were brought forward a few years ago at a meeting of the Institution of Civil Engineers that the effect of thoroughly aërating cement increased the bulk by 6 per cent. and it was also stated that the added bulk thus obtained paid for the cost of turning. As to Mr. Max Clarke's criticism of the experts, he thought he was very hard upon them. He knew it took experience to be able to test cement, and he had had twenty years of it himself, and it was only to be expected that a man who was always at it, as his assistants were, were able to do it better than those who did it once in a month. It was merely a question of manipulating the tools properly. The object of testing cement was, he took it, to know what it would do under the best conditions, for by taking the best conditions they got a criterion, and on the works they could not expect to approach these conditions.

Mr. Spencer, in acknowledging the vote of thanks, said that with regard to Mr. Butler's criticism he had seen his statement as to the cooling before, and had never quite understood it. Did Mr. Butler mean that aëration lessened the quick-setting properties.

Mr. Butler: Certainly.

Mr. Spencer said Mr. Butler admitted apparently that there was lime in the cement in a state of activity with regard to water, and it was known that water-slaked lime would cause a rise in temperature.

Mr. Butler said it might be in a slight degree due to the free lime, but it was so slight as to be negligible.

Mr. Spencer said that Mr. Humphreys' point was that, whether due to quick setting or lime, the cement should be properly aerated if it did not rise 6 deg. when treated with water.

Mr. Butler: Then I say that if it only showed 2 deg. it might be thoroughly unsound.

Mr. Spencer said Mr. Humphreys did not say that, he merely showed that they should not treat it as unsound because it was fresh from the mill. If they found it unsound before cooling it to that extent, they would be sure they would not improve it by aerating.

Mr. Butler: The chances are that by aërating it you would make it sound.

Mr. Spencer said that was so, and Mr. Humphreys wished to give it every chance. He would not consider the cement fit to put in the work before aëration. Several members asked a question as to what Mr. Humphreys thought the best aggregate for floors, and he believed he advocated furnace clinker. He did not know the proportion.

Mr. Claxton answered a question as to furnace clinker, and said the clinker they used was refuse-destructor clinker.

Mr. Spencer added that Mr. Humphreys did not wish to put forward Messrs. Johnson's cement any more than any other.

The meeting then terminated.

UNITARIAN CHURCH, BIRKENHEAD.—The old Unitarian Church at Charing-cross, Birkenhead, having been pulled down, it became necessary to find a new building. This is now being built in Bessborough-road, Oxton, where a school building has already been erected. The church is from the plans of Mr. J. J. Talbot, Liverpool, and will consist of nave, transepts, and chancel, with a gallery over a large waiting hall at the entrance end of the building.

Illustrations.

STUDIES FOR A MADONNA AND CHILD.

THESE illustrations are reproduced from two studies made by Mr. Westlake for a life-size painting of the Madonna executed as a commission from the Marquis of Bute, for the church at Old Cannock built for him from Burges's designs.

The Madonna is represented in this case as the "Mater humillima," and the representation is purposely carried out in the style of a good many ancient paintings of the same class. The colours are limited to brown and blue, the lights being assisted by gold hatching. In the study, as well as in the finished painting, the ground is gold, but it was impossible to represent this in lithograph, unless by a strong yellow, which has not a satisfactory effect; and the ground has therefore been kept dark, as the best means of making the figure stand out from it in somewhat the same decisive manner in which it would stand out from gold.

Mr. Westlake thought it would be of interest to place the study from life, specially made for the picture, alongside of the finished study. The process of translating, as it were, an Italian woman and child into a Madonna, is exactly that which we come across in comparing Raphael's figure studies with his Madonnas, except that in his more naturalistic school the difference between the original model and the picture is much less than in this case, where the finished study is purposely treated in a conventional and ecclesiastical manner.

The young Italian woman (now dead) who furnished the model was well known to various London artists under the name of Maddalena Fionda; she came from Picinisco near Monte Cassino, a neighbourhood noted for the pure Italian type of beauty among its inhabitants, who are called "Greeks" by the other Italians.

Both studies have been exhibited at the Royal Academy.

THE PALACE OF CHARLES V. AT GRANADA.

LA GIRALDA AT SEVILLE.

"SYMBOL of himself and Spain, great in conception and impotent in conclusion," is Ford's characteristic description of the Palace of Charles V. at Granada. The apparent completeness of the elevation, elaborately worked even to its sculptured details, hardly prepares the visitor for the mere abandoned shell that a closer inspection of the structure reveals. Devoid of either floors or roof, the massive masonry walls remain standing after nearly 400 years in an astonishing state of preservation, and little imagination is required to reconstitute the original design.

To assert that this building has suffered unjustly from proximity to the Alhambra is to record a simple fact, for it is even amusing to observe how visitors, intent on the novelties of Moorish art, have no eyes for a palace design which would be their centre of attraction in any other city in Spain.

Of the middle period of the Renaissance, this Palace is on the whole the finest specimen of the style in Spain, for though the early period of fresh and fanciful design had passed, the grandiose but dull formalism of Herrera and his followers had hardly begun to sterilise the Renaissance art of Spain. We are, in fact, in the presence of the work of an immediate follower of Bramante and Raphael.

The Palace was begun by Charles V. in 1526 as a Royal residence, in the lately conquered Moorish kingdom, and within the fortified hill of the Alhambra, immediately adjacent to the Moorish Court.

The architect was Pedro Machuca, who had studied in Italy among the band of brilliant pupils who gathered round and associated with Raphael. In the fashion of the day Machuca appears to have been a painter as well as an architect, and on coming to Granada in 1524 is said to have worked on Retablos for churches. He directed the Palace works for twenty-four years, dying in 1550. His son, then twenty-five years old, carried it on up to 1568, when the rebellion of the oppressed Moors caused the abandonment of the undertaking. This son died in 1572, and the expulsion of the Moors in 1610 caused the final ruin of the province.

The great masonry walls are well executed in a fine golden coloured stone, described by Ford as a "creamy pudding stone called Almendrado, from the quarries of El Turro." The centres of the two façades are of coloured marbles, white, green, black, and red. This colouring is managed with great skill, and without the dissonance of effect that the mingling of sandstone and marble might suggest.

The sculpture by Berrugete is very cleverly and finely executed. It is anatomical in character, after the influence of Michael Angelo's work. The bas-reliefs have figures, three-quarter turned to the spectator, exhibiting the play of muscles involved in such intricate positions. Some of the work is in much lower relief, as in the dies of the pedestals of the order. Some groups of boys riding on dolphins are put in with considerable effect of life and motion, but the more elaborate spandril figures are somewhat tame and stiff.

The circular court inside promised to be a fine feature, with its free standing columns and grand unbroken sweep of entablature, but only the lower order is properly completed; the upper, very low in relative proportion, is perhaps not according to the original intention.

There is a key plan of the palace in Ferguson (vol. iii.), and a somewhat more sympathetic criticism of the design than is usual with him, when dealing with Renaissance work.

The Giralda at Seville, so called from the vane which turns ("gira"), is happily described by Ford in his well-known "Handbook to Spain," as "a rich filigree belfry, elegant and attractive beyond description." Here Renaissance work so follows on Moorish that the whole tower is commonly regarded by visitors as one design. A close inspection will show the student that more of the Moorish core still remains in the upper part than his first impression will anticipate. The designer has triumphed over the shackles of the older work, and so capped the tower as to appropriate the old as the base of the new.

It is difficult, however, to say much for the detail of the Renaissance stages. It is one of those rare instances where the proportion and outline of the whole command success, in spite of the most grotesque detail. The flowers and their pots are of bronze, and the inlay shown in the pilasters, &c., is of ordinary Spanish glazed tiles, apparently black, but changing to the deep blue of the sky, in the strong sunlight of the south. The brickwork is pale red, and the stone slightly yellow with the same blue inlay in parts. The colour combination would be an utter failure in every probability in any northern climate, just as it would be a great experiment to undertake to revise the detail of the tower without the loss of its exceptional grace of outline. The reproduction of the tower at the last Paris Exhibition, in the Spanish quarter, completely failed to give the effect of the original.

The Moorish shaft is given in Ferguson as 185 ft. high by 45 ft. square, and it is suggested that it was built to commemorate the victory of Alarcos gained by the Moorish King Yousouf in 1159. Ford, however, gives 1196 as the date. The Renaissance addition was made in 1568 by Ferdinando Ruiz.

It will be noticed that the tower has no steps up but a vaulted inclined way winding round an inner shaft. The hanging of the bells, as shown, is the characteristic Spanish method, its picturesque effect is helped by the piled up headstock, required to counterbalance the bell which is pulled down by a short cord until it keeps turning round and round head over heels. The ringers pass round behind the bells by the passage between the outer and inner walls. For the largest bells the clapper is thrown by a cord against the side of the bell without the bell being swung.

The complete inscription is "Nomen Dei Fortissima Turris—Proverbs xviii. 10"—one word on each face. The upper stages of the tower as drawn were carefully measured up to the bronze turning figure on top, which is about 14 ft. high and is said to weigh 2,800 lbs. This was quite inaccessible, as there was no scaffolding available. The figure is of Faith carrying the labarum or standard of Constantine. It was cast by Bartolomé Morel in 1568.

All necessary permission and free access to the tower were granted with much courtesy by the Spanish clergy.

These drawings were made by the author during his Soane Medallion Tour in 1893.

A. T. BOLTON.

REREDOS, ST. KATHARINE'S CHAPEL, QUEEN-SQUARE.

WE have not received any information from the architect, Mr. John Medland, in regard to this design for a reredos. From the treatment of the drawing, it is apparently a work in carved wood, and is richly decorated with canopy work and figure subjects.

ST. LUKE'S CHURCH, MAIDSTONE.

THIS design was submitted to the promoters in conformation with instructions to provide a church in which all present at a service could see the preacher, and in which the choir were to occupy an inconspicuous position in one of the transepts. It was abandoned in favour of the usual three-aisled church, in deference to the views of the late Archbishop of Canterbury.

W. H. SETH-SMITH.

"GILLINGROVE," KENDAL; AND CURATE'S RESIDENCE, STANMORE.

THE first-named house of these two is situated at the top of some high land overlooking the grey old town of Kendal and at the head of the Gilling grove, which, during flood time, pours a torrent of broken water down the steep, declivity to the River Kent.

At the time it was built it formed the first attempt to introduce into the sombre town a little bit of colour and irregular skyline, and so far has this succeeded that visitors to the district find in it a pleasing relief to the surrounding uniform and square-built limestone buildings.

Mr. John F. Curwen, the architect, designed it to have a lower story of dressed limestone, the upper portion to be covered with red hanging tiles, red Ruabon chimney-stacks, and the whole covered with a steep roof of brown tiles. It was entirely built by local builders at a cost of 2,005*l*. 14s. 6d.

The Curate's Residence at Stanmore, Harrow, was designed by the same architect at the same time, in red bricks and brown tiles, and carried out at the comparatively small cost of 1,590*l*.; Messrs. George Kirby & Sons being the contractors.

CAMBERWELL BATHS COMPETITION.

THIS competition, the drawings of which have been on view at the present baths, has attracted fifty-two competitors, and the general character is above the average and includes some very excellent work.

It is somewhat bewildering to examine individually such a collection, as the requirements and restrictions which the limited site affords do not give scope for much variation in general. Two great swimming baths had to be provided, 130 slippers, thirty-two douches, Turkish baths, a complete parochial wash-house, and the necessary administration, all of which had to be dovetailed into the site, which is situate in the Old Kent-road, the long side of the site being to Marlborough-road.

The planning of a great bathing establishment must necessarily be subjective to a full knowledge of the working and administration of the same. The great extent of these swimming baths and their non-use for bathing during the winter has brought in a new element in their utilisation for entertainments. In so doing they are brought within the province of the theatre regulations of the London County Council.

These two elements have, therefore, to be assimilated in the production of a successful plan in compliance with the letter of the law in the matter of egress and exit, and the many conflicting details which are inseparable from the bathing requirements.

It is, then, not to be wondered at that there is so much similarity in the plans. The assessor's task has therefore not been an easy one, and the only way to arrive at a just result is the course which no doubt has resulted in the selection of No. 18, Mr. E. Harding Payne, who receives the first premium, 150*l*., for of all the designs this one seems to contain the greatest number of good points, without being what we should term the best all-round design; but in its selection we entirely concur. Some minor points of detail it may be desirable to improve without affecting the general principles, and a very excellent plan will result.

The two swimming baths are placed side by side the long way of the site, parted from Marlborough-road by a narrow corridor, the utility of which is not quite clear; the second-class bath would probably have to be closed while the other is in use for entertainments. Provision has been made for artistes' rooms, and separate access thereto. The slipper baths are placed partly upon the ground and upper floors; the lighting to the latter might be improved. The galleries seem rather narrow, 2 ft. for seat and passing being too small. The same applies to the gangways and staircases, which require extra width.

A very excellently arranged Turkish bath is provided in the basement, while the wash-houses are disposed at the rear of the site.

The elevations are inferior in quality to the plan; they are red brick with stone dressings. As we have before remarked, this design seems to embody most of the essential points necessary to such an institution.

The second premium is awarded to No. 7. Messrs. Russell & Mallows, who show an excellent all-round set with many good points. The first-class baths are on Marlborough-road, and a good and original idea is secured by utilising the second-class bath for a crush-room, supper-room, and cloakrooms. This consideration has, however, resulted in the second-class bath having been sunk to below the level of the sewer, so that it would have to be emptied by a centrifugal pump. This, no doubt, has been considered an obstacle, notwithstanding the fact that it could be emptied quicker than by running the water away. The elevations are strongly executed in Renaissance, a tower being a prominent feature, but the detail is rather overweighted for a building of this character, the lower part being out of scale with the upper. The plan, excellent thought it is, falls behind the selected design in good and necessary points.

The third premium is awarded to No. 32, Mr. H. Dighton Pearson. This plan is not unlike the first noticed; the access to the artistes' rooms is not fully considered, and though it is full of admirable working points, it lacks the compact qualities of the first premiated design. The latter is somewhat deficient in practical and technical information, while Mr. Pearson's sections show minute study of the requirements; the elevations are also more satisfactory than those placed first.

After inspecting the majority of the designs, a large number of which are evidently by architects who have had practical experience of the construction of public baths, a return to the selected design demonstrates that it is evident that its combination of good points has gained the award.

No 9 shows a capital set of drawings, but placing the men's slipper baths at the rear, partly over the public wash-house, is not the best arrangement. The elevations were among the best in the exhibition; the style is latter-day Renaissance, but the general character of the design is hardly expressive of baths.

No. 34 has, at first sight, rather a straggling look, the second-class bath being at the rear on a diagonal line, bisecting the site into first and second class. The vexatious gallery question is cleverly solved by omitting it over the dressing-boxes, which are kept distinct on the east side, the space under the galleries being utilised for cloakrooms and stores, thus improving the character of the entertainment hall.

The elevations are red brick and terra-cotta, and are of a suitable and interesting character. No. 27 is an interesting and characteristic design, beautifully drawn, the elevations being simple, elegant, and refined, and evidence more knowledge than is displayed in the plan. No. 20, on the other hand, is uninteresting and commonplace in regard to external adornment, but the plan shows much practical knowledge. The two great baths are placed *en échelon*, with good direct exits and supervision, one particular feature being the placing of the men's second-class slipper baths around the gallery of the second-class bath.

No. 48 is a strongly executed set, not without character in the elevations, which are loaded and heavy. No. 11 has a remarkable similarity to No. 34; in this design the dressing-box question is again tackled, the boxes being placed below the galleries in bays. The whole set had much good suggestion. No 4. has simple and dignified expression in the elevations. No. 6 is one of the few designs which attempt a definite idea, the second-class bath being placed upon Marlborough-road, and is made a crush-room to the entertainment hall or first-class bath. No. 37 arranges his swimming baths by placing them at right angles to one another; but the plan becomes involved. No. 40 has points not unlike No. 6; the slipper baths being placed to the front and back of the site is not the best arrangement for supervision.

INCRUSTATION ON ST. PAUL'S CATHEDRAL.

IN a recent "Note" in the *Builder* reference was made to the paper read by Mr. E. G. Clayton before the London Chemical Society on the subject of incrustations taken from the Portland stone balustrade round the base of the dome of St. Paul's Cathedral. Some further consideration of the subject may be of interest.

This balustrade is surmounted by a heavy coping stone of the same material; much of the surface is greatly "weathered," and is coated by a stratum of a grey or black substance which in some places (especially on the under side of the coping stone) attains a thickness of ¾ in. This material, which is brittle and detachable with a knife, has a very rough and irregular surface, is stalagmite in character, and though differing in colour, in other respects resembles very closely some boiler deposits, and is easily reduced to a fine grey powder.

Analysis of the Incrustation.

Water (lost at 100 deg. C.)	2·06
Water (lost at 150 deg. C)	22·48
Organic matter	1·10
Lime	26·44
Magnesia	·27
Ferrous oxide	1·31
Sulphuric acid (combined)	34·93
Phosphoric acid	1·02
Carbonic acid	none
Chlorine	trace
Silica, sand, &c.	10·39
(including combined silicic acid, SiO_3, 2·33)	
	100·00

From the above results the substance is evidently composed chiefly of hydrated sulphate of lime associated with some siliceous matter and minute particles of carbon in the form of soot. The solvent action exerted by rain charged with sulphurous and sulphuric acid derived from the gases and smoke of innumerable chimneys of the surrounding buildings, has after the lapse of two centuries transformed the original carbonate of lime of the Portland stone into sulphate of lime, which in a more or less soluble condition has been carried by water action and gradually deposited as calcareous tufa or stalagmite on the underside of the coping-stone.

The practical conclusion to be drawn from this research is very obvious, namely, that buildings in large cities, and especially in manufacturing towns, should not be constructed of limestone, which is readily decomposed by the acids existing in the smoke due to the use of coal largely impregnated with sulphur.

Granite and hard sandstone appear much better adapted for city buildings, but stone of a calcareous character was doubtless originally employed on account of its being more readily and therefore more economically worked into suitable shape by the stone cutter.

JOHN HUGHES.

COMPETITIONS.

HOSPITAL, BEXHILL.—In the competition for an isolation hospital, Bexhill, the design placed first was that sent in by Mr. Francis D. Smith, Parliament Mansions, Victoria-street, Westminster, and the second premiated design was by Mr. J. H. Cossar, Borrowash, Derby. The selected design was sent in by Mr. T. S. Inglis, Savernake-road, South Hampstead.

LAYING OUT GROUNDS AT BEXHILL.—In this competition the first premiated design was that sent in by Mr. J. W. Webb, of Bexhill, and the second was by Mr. J. Cheal & Sons, Crawley, Sussex.

COLEFORD SEWERAGE AND WATER SUPPLY.—The Coleford Urban District Council have adopted schemes of water supply and sewerage for that town prepared by Mr. Harry W. Taylor, of Newcastle-on-Tyne and Birmingham. The water will be obtained from a deep boring in the old red sandstone; the sewage will gravitate to the outfall and be disposed of bacterially. The estimated cost is 10,000*l*.

ARCHÆOLOGICAL SOCIETIES.

SOCIETY OF ANTIQUARIES. — At the last meeting of this Society, Mr. W. Gowland read a paper on the recent work at Stonehenge. He said that he had had the honour of being chosen as the representative of the Society during the carrying out of the recent works at Stonehenge in raising the leaning stone to an upright position, and in examining the excavations made for this purpose. This work was effected by enclosing the stone in a cradle, and hoisting it up by winch power. When erect, the base was bedded in concrete, and the work, he believed, would be of lasting character. The various stages were illustrated by lantern-slides thrown on the screen. The excavations had been carefully mapped, and it would be possible to fix the locality where any of the objects were taken. The earth had been carefully sifted so that the tiniest fragment could not escape observation. Beneath the surface layer was rubble, overlying the chalk in which the stone was bedded. Mixed with the soil and rubble were lumps of sarsen, chips of diabase, hornstone representing the "bluestone" uprights, and flints rudely chipped or shaped into hammers, probably used in dressing the stones. The sarsen uprights and cross pieces showed signs of tooling, and a slab was exhibited side by side with a piece recently worked with one of the flint tools to show the tooling could be done with these implements. Large stone mauls were also found, probably employed for rough dressing the stones. A few bones and teeth of no interest were met with, and a pick made from a deer's antler. The only traces of metal were a copper-stained stone and a Roman coin. The stone tools and implements were of a rude type, quite different from what we usually associate with Neolithic times, but this might, perhaps, be accounted for by the somewhat rude purpose to which they were put. The transport and erection of the stones, Mr. Gowland said, offered no difficulties that might not have been overcome by the Neolithic men, and by means of lantern slides he showed how heavy stones were moved by man-power in Japan, and referred to Poynter's picture of the transport of a monolith in Ancient Egypt. He would fix the date of Stonehenge near the later part of the Neolithic period, and this would probably carry us back to 1800 or 2000 B.C. Its purpose was that of a sun-temple, and its analogue might be seen in an antique engraving exhibited on the wall. This he had brought from Japan. It represented the worship of the rising sun, a trilithon, an altar, and upright stones forming a line between that and the worshippers. These megalithic monuments were not copied by one people from another, but were the outcome of development on similar lines. Sir Norman Lockyer make some remarks on the astronomical view of the question, and the resemblance of the banks at Stonehenge to the stone avenue at Carnac, and the Sphinx avenues in the Egyptian temples. He thought it probable that Stonehenge might have served a religious purpose, but they should not unduly labour the point that such structures were connected with any kind of sun-worship, though the inner circle at Stonehenge resembled the Naos of the sun-temples. One of the chief necessities of early man was the measurement of time, and that these structures might be made to subserve. The astronomical results of the work done at Stonehenge in the determination of the temple axis gave a date of 1680 B.C., with a minus variation of about 200 years.

CRYSTAL PALACE ENGINEERING SCHOOL.—The "Wilson" premium for the best paper read before the Crystal Palace Engineering Society during the present session has been awarded by the Council to Mr. S. J. N. Carrington for his paper on "The Widening of the Brighton Line between Balham and Croydon." Other papers read during the term were "The Eastbourne Pier Improvement Works," by Mr. J. M. Attlee; "Trade Unionism," by Mr. F. H. H. Williamson; and "Modern Electricity," by Mr. E. A. A. Parsons. The premium was presented to Mr. Carrington by Colonel Raban, R.E., Director of Works to the Admiralty, on the occasion of the eighty-seventh distribution of certificates at the above school on December 20.

LIVERPOOL ARCHITECTURAL SOCIETY. — The second members' meeting of this Society was held on the 16th inst. in the Law Library, Castle-street. Mr. C. J. Andersson presided. Mr. C. Brien read a paper on "Wood Staining and Veneering," illustrated with specimens of woods and stains. Mr. James Cook afterwards exhibited a series of lantern slides of French cathedrals.

The Student's Column.

GAS AND GAS-FITTINGS.

26.—BRITISH LAWS AND REGULATIONS RELATING TO ACETYLENE AND CALCIUM CARBIDE—FIRE INSURANCE.

WHEN calcium carbide was first placed upon the markets as an article of commerce very little was known by the general public concerning its nature and properties, and a number of acetylene generators were constructed which were a source of danger to those to whom they were sold. Fatal accidents, moreover, occurred in America and on the Continent, owing to the attempt to use acetylene compressed and liquefied in metal cylinders under high pressures, and it was not until acetylene in this condition had been proved to be an extremely dangerous explosive that the use of compressed or liquefied acetylene was abandoned. The British Government speedily recognised the desirability of safeguarding the public by introducing reasonable regulations as to the conditions under which carbide and acetylene may be used, and public confidence in the new illuminant has been restored by the fact that, since these regulations have been enforced, acetylene has been extensively used in this country under a great variety of conditions with very few serious accidents.

Acetylene has now been used for a sufficiently long period, and in sufficiently large quantities, to prove that it may be safely used by the general public for all ordinary illuminating purposes, provided that the conditions under which it is used do not violate any of the legal enactments, of which brief digests are given in the present chapter, and that such reasonable precautions are taken as are set forth in the printed Regulations issued by the Public Control Department of the London County Council for use within the area under the jurisdiction of that Council.

The Storage and Transport of Carbide.

Calcium Carbide placed under the Petroleum Acts.—By an Order in Council, dated February 26, 1897, calcium carbide is brought under the Petroleum Acts, 1871 to 1881, with the deletion of certain clauses which relate only to petroleum and similar liquids, and with the following additions:—

The label on a vessel containing calcium carbide must bear in conspicuous characters the words:—

"Carbide of Calcium."

"Dangerous if not kept dry."

"The contents of this package are liable, if brought into contact with water, to give off a highly inflammable gas."

Also every package or vessel must bear upon it:—

(*a*) The name and address of the consignee or owner, if the package is to be kept.

(*b*) The name and address of the sender, if the vessel is to be sent or conveyed.

(*c*) The name and address of the vendor, if the vessel is to be sold or exposed for sale.

Licence Required.—Under the Petroleum Acts it becomes unlawful for any person to keep any quantity of calcium carbide, whether for sale or for use, without a licence from the Local Authority. By an Order in Council, dated July 7, 1897, a quantity of calcium carbide not exceeding 5 lbs. is permitted to be kept without a licence on any premises, provided that it is kept in "separate, substantial, hermetically closed metal vessels containing not more than 1 lb."

Where calcium carbide is to be stored in greater quantities than 5 lbs. in 1-lb. tins, a licence, granted for a sum not exceeding 5s. per annum, must be obtained from the Local Authority, and must be renewed every year. The conditions to be attached to such licence rest entirely with the Local Authority, and may vary in different districts, but usually only such reasonable conditions as are required to afford protection in the use and storage of the carbide are written upon the licence. In most districts the issue of carbide licences is made from the office of the surveyor to the Borough or District Council, but in the area controlled by the London County Council the licences are issued from the Public Control Department of the Council after inspection of the premises and of the vessels in which the carbide is to be stored, and the apparatus in which it is to be decomposed, by one of the Council's inspectors.

Acetylene.

Liquid or Compressed Acetylene Prohibited.—By an Order in Council, dated November 26, 1897, acetylene is declared to be an explosive when in a liquefied condition, or when subjected to a pressure exceeding 100 in. of water, and in such condition acetylene is "prohibited from being manufactured, imported, kept, conveyed, or sold."

Exception.—"If it be shown to the satisfaction of the Secretary of State that acetylene declared to be an explosive by this Order when in admixture with any substance, or in any form or condition, is not possessed of explosive properties, the Secretary of State may by an Order exempt such acetylene from being deemed to be an explosive within the said Act."

Compressed Mixtures of Acetylene and Oil-Gas.—By an order of the Secretary of State, dated March 28, 1898, it is ordered that a mixture of acetylene and oil-gas not containing more than 20 per cent. by volume of acetylene, and not subjected to a greater pressure than 150 lbs. to the sq. inch, shall not be deemed an explosive within the meaning of the Act, provided that the acetylene and oil-gas be mixed together before the gases are compressed.

Acetylene compressed into Porous Substances.—Certain substances have the property of absorbing a large proportion of acetylene when the gas is passed into them under pressure, and of evolving the acetylene in a continuous stream when the pressure is relieved or the temperature of the substance is raised. The substance containing this absorbed acetylene does not possess the explosive character of liquefied or highly-compressed acetylene. The liquid known as acetone is capable of absorbing 300 times its own volume of acetylene when the gas is passed into it under a pressure of 180 lbs. per square inch. An Order of the Secretary of State (No. 6), dated April 10, 1901, declares that acetylene, when compressed into porous substances, with or without acetone, shall not be deemed to be an explosive within the meaning of the Act, provided that the porous substances to be used shall be similar in every respect to samples deposited at the Home Office, that the pressure does not exceed 150 lbs. to the square inch, and that certain other conditions set forth in the Order are not violated.

Acetylene Mixed with Air Prohibited.—By an Order in Council, dated May 15, 1900, it is ordered that acetylene in admixture with air or oxygen shall be prohibited from being manufactured, imported, kept, or sold. Nothing in this order applies to mixtures produced by admitting air into the burner, or to air unavoidably admitted into the generator when recharging.

Conditions of Licence from Local Authority.

Local authorities may attach any conditions which they consider necessary to the carbide licences issued in the districts over which they have control, but the printed regulations issued by the London County Council may with advantage be used as a model by other local authorities, and the following extracts therefrom include all the essential conditions.

London County Council.—In addition to the regulations as to the labelling of vessels containing carbide to which reference has already been made, the London County Council grant licences within the County of London upon the following conditions:—

1. Application to the Council for a licence to keep carbide of calcium at any place in the County of London (except the City of London) must be made upon the form provided for the purpose, which can be obtained by application in writing, addressed to the Chief Officer, Public Control Department of the London County Council, 6, Waterloo-place, S.W.

2. Every application must be accompanied by a fee of 5s. in money, or, if sent through the post, by cheque or postal order for that amount payable to the order of the London County Council. The fee will be returned to the applicant if the licence be not granted.

3. Every application must state—

(*a*) The quantity of carbide which the applicant desires to keep;

(*b*) The proposed place and method of storage;

(*c*) If the carbide is only to be kept in closed vessels, or if it is to be used in the manufacture of acetylene gas.

4. Carbide of calcium should be kept in strong metal vessels, and—

(*a*) Such vessels should be constructed and closed as to prevent the admission of water or atmospheric moisture.

(*b*) Such vessels should only be opened for the time necessary for the removal of any required quantity of carbide, or for the refilling of the vessels.

(*c*) No vessel should have a greater capacity than 3,696 cubic inches (equal to a cylindrical vessel 14 in. in diameter and 24 in. in depth).

(*d*) Every vessel of a greater capacity than 2 lb. should be provided with a lock or be placed in a locked receptacle, so as to prevent unauthorised persons gaining access to the contents.

(*e*) Copper should not be used in the construction of vessels for containing carbide.

5. Vessels containing carbide of calcium should not be kept inside dwelling-houses, but preferably in dry and well-ventilated outbuildings.

6. Small quantities of carbide for sale or immediate use will, however, be allowed in shops, dwellings, or workshops, upon licensed premises, if the arrangements are satisfactory.

7. The Council proposes only to grant licences to keep carbide of calcium which is pure (in a commercial sense), *i.e.*, which contains no impurities liable to generate phosphoretted or siliciuretted hydrogen so as to render the gas evolved liable to ignite spontaneously.

8. Where carbide of calcium is kept for the manufacture of acetylene gas, it is desirable that such of the following precautions for ensuring safety as are applicable to the circumstances, should be adopted :—

(*a*) Every apparatus for generating and storing acetylene gas should be placed in an outbuilding. (This does not apply to portable apparatus holding a charge of less than 2 lbs. of carbide.)

(*b*) Such building should be situated as far as may be practicable from inhabited buildings, and should be well ventilated.

(*c*) No fire or artificial light as would ignite inflammable gas should be taken into or near the building or place where a gasmaking apparatus is situate.

9. Every apparatus (including generator and gas holder) used for acetylene gas should as far as practicable be constructed and used so as to provide against the special risk, *i.e.* :—

(*a*) Copper should not be used in any part of the apparatus ;

(*b*) The various parts should be of adequate strength ;

(*c*) Escape of gas from the apparatus should be carefully guarded against ;

(*d*) Satisfactory provision should be made against dangerous development of heat ;

(*e*) Satisfactory provision should be made against undue pressure by the employment of an adequate safety valve connected with a pipe discharging into the open air, and a suitable pressure gauge should be attached to the apparatus ;

(*f*) Provision should be made for the residue of the carbide being mixed with at least ten times its bulk of water on being removed from the apparatus ;

(*g*) No person should have charge of an apparatus until he has been properly instructed in its management.

10. Licences are granted for keeping carbide of calcium for periods not exceeding one year, and prior to expiration application must be made for their renewal. Notice of the expiration, and a form of application for renewal, is sent to each licensee at the proper time.

With reference to the foregoing regulations it may be mentioned that under certain conditions, which seldom exist in practice, copper may be attacked by acetylene, and a highly explosive compound, known as copper acetylide, formed. Danger from overheating or excessive pressure only exists when generators of faulty design or construction are employed.

Danger of spontaneous ignition of the acetylene through the presence of impurities in the carbide does not exist at the present time, because the quantities of phosphuretted hydrogen and silicuretted hydrogen evolved from the carbide now manufactured are much below the danger limits.

The following is a copy of the "application form" for a carbide licence issued by the London County Council :—

LONDON COUNTY COUNCIL.

PUBLIC CONTROL DEPARTMENT.

PETROLEUM ACTS, 1871 TO 1881,
And Orders in Council dated February 26, 1897, and July 7, 1897.

.....Reg. No.

Application to the London County Council for a Licence to keep Carbide of Calcium.

This application should be fully filled up in accordance with the following instructions, and forwarded to the Chief Officer of the Public Control Department, London County Council, 6, Waterloo-place, S.W., with a P.O. or cheque for 5*s.*, payable to order of the London County Council and crossed This fee will be retained if the licence be granted, or returned to the applicant if the licence be refused.

State Christian name and Surname of the applicant. If a firm, the names of each member in full. If a company, the name of the company and its secretary.	
State situation of the premises for which the licence is required.	
State quantity desired. If the quantity is 10 cwt. or more, a plan must accompany this application, showing the proposed place and method of storage, and the buildings within 50 ft. of such place. The plan must be to the scale of ⅛ in. to 1 ft.	
State if the carbide will be kept and sold unopened in the vessels in which it is received, and, if not, what will be done with it.	
State in what vessels the carbide will be kept, capacity of vessels, how closed against moisture, and of what material constructed.	
State (*a*) in what part of the premises the carbide is to be kept ; (*b*) the construction of the store ; (*c*) if the store is used for other purposes, and, if so, what.	
State if the carbide is to be used for the manufacture of acetylene gas, and if so, state— (*a*) The make and capacity of the generator. (*b*) Particulars as to the building in which it will be placed, if detached from other buildings, and if used for other purposes. (*c*) How you propose to dispose of the residue. (*d*) If the machine will be in the sole charge of a person properly instructed in its management.	

Signature of Applicant _____

Trade or Profession _____

Postal Address _____

Date _____ 190 .

Corporation of London.—The conditions upon which the Corporation of London grant licences for the storage of carbide are very similar to those of the London County Council. The carbide has to be kept in metal vessels approved by the City Surveyor, and the place of storage, which must not be an inhabited house, has also to be approved by the City Surveyor.

Fire Insurance.—Fire Insurance Companies do not, as a rule, charge any extra premium on buildings in which acetylene is used, provided that the generator is located outside the building ; but notice should be given to the Insurance Company when the installation is introduced, and the insurance policy should be endorsed by the company to the effect that the use of the apparatus for the generation and combustion of acetylene is permitted. Some companies issue a printed list of rules for buildings in which acetylene is generated or carbide is stored, and for buildings in which acetylene is consumed ; but these are usually merely repetitions of some of the London County Council licence regulations which have already been enumerated.

GENERAL BUILDING NEWS.

REOPENING OF HACCONBY CHURCH. — The Bishop of Lincoln reopened the Parish Church of Hacconby, South Lincolnshire, on the 14th inst. The Earl of Ancaster, who is lord of the manor, undertook certain sections of the work, including the restoration of the chancel and side chapel, the tower, and the provision of seats for the chancel. The other portions of the work have been effected by public subscription. The whole of the work has been carried out to designs by Mr. C. A Bassett-Smith, the architect, Messrs. Halliday, of Stamford, being the contractors.

HOLY TRINITY CHURCH, PRINCE CONSORT-ROAD, S.W.—On December 12 the Dean of Westminster laid the corner-stone of this new church, upon a site in Prince Consort-road which has been acquired from the Commissioners for the Exhibition of 1851. Towards the total cost, exceeding 25,000*l*., are apportioned the proceeds of the sale of the site and materials of the church of Holy Trinity, Knightsbridge, erected in 1860-1, after the designs of R. Brandon and H. M. Eyton, and illustrated in the *Builder* of April 21, 1860. The church, designed by Mr. G. F. Bodley, A.R.A, will have a capacity for about 800 persons. The buildings comprise a morning chapel, vestries, a parish-room, and a vicar's house. The style, we learn, will be English Gothic, after the manner and character of a town church in the fourteenth century, with a wide nave and chancel aisles. A new parish of Holy Trinity will be constituted, the benefice of the present Holy Trinity church having been united with that of All Saints' church in Ennismore-gardens.

MONIKIE PARISH CHURCH, FORFAR.—Monikie Parish Church has just been reopened after being restored. The interior of the building has been practically reconstructed, the internal fittings, gallery, and woodwork entirely cleared out, and substantial wood flooring put in. In place of the gallery stretching round the east, north, and west sides of the structure, one main gallery has been erected at the west end of the church, while the pulpit has been removed from its original position adjoining the south wall to the east side. The old windows set in the north wall are converted into lancet windows, and the whole have been reglazed with lead light. Over the pulpit in the east gable a new three-light window has been formed. All the sittings have been renewed in pitch pine. The operations were conducted under the supervision of the architect, Mr. James H. Langlands, Dundee. The contractors were :—For mason work, Mr. Charles Dick, Monifieth ; joinery, Messrs. A. Bruce & Son, Dundee ; plaster work, Mr. John Doig, Forfar ; slater work, Mr. Alexander Hogg, Carnoustie ; heating and plumbing work, Messrs. A. L Peacock & Co., Dundee ; painter work, Messrs. P & A. Davie, Dundee.

WESLEYAN CHAPEL, MARLOW.—A new chapel was opened for the Wesleyan community at Marlow recently. The new chapel has been erected by Mr. Y. J. Lovell, builder, of Marlow, from designs prepared by Mr. R. Wellicome, architect, of Marlow. Externally, the edifice is constructed after the Renaissance style, and red bricks have been used with Bath stone dressings. The interior is approached by a semi-circular porch. The floor of the porch is paved with mosaic. On one side of the central gable a staircase has been erected, which leads to a gallery situated at the southern end of the building. Internally the chapel is 31 ft. 6 in. in width by 51 ft. in length, and accommodation has been provided for 300 persons.

COUNTY SCHOOL, MILFORD.—On the 4th inst. new County School buildings were opened at Milford. The schools, which have been erected at a cost exceeding 2,000*l*., consist of a stone building relieved by Bath stone. They will provide accommodation for 100 students, and there is an assembly hall, classrooms, kitchen for cookery classes, with the usual cloakrooms, &c. The floors are all wood block Adjoining the buildings are two playgrounds, divided for boys and girls. The architects were Mr Walter J. Wood, of London, and Mr. J. B. Gaskell, of Milford Haven, and the contractors Messrs. George Cole & Sons, of Milford Haven.

NATIONAL SCHOOLS, STOCKPORT.—New National day and Sunday schools have been erected at Spring Gardens, Churchgate, Stockport. The site of the present schools and the buildings at Wellington-road South, directly opposite the Stockport Infirmary, have been acquired by the Corporation with a view to the erection of a town hall and

municipal buildings. The new schools will cost about 8,000*l.* The buildings occupy an elevated site; there are separate departments for boys, girls, and infants, and an assembly-room, the accommodation being for 600 day scholars. Messrs. Stott & Sons, Manchester, are the architects, and Mr. Josiah Briggs, Stockport, builder.

POST OFFICE, SWANSEA.—The new Swansea Post Office has been erected on the site of the old Mackworth Hotel, in Wind-street, Swansea, and runs back to the Strand behind. The façade in Wind-street is stone, relieved by carvings and granite pillars. The parapet is surmounted by four stone figures, emblematic of the four countries of Great Britain, Wales and England being central and prominent. There is an ornamental tower above. There is to be a porch over the main entrance. The side elevation in Green Dragon-lane is built of bricks, and there is a separate entrance for the female staff and the public having business with the principals of the various departments. The rear of the building is faced with buff bricks and stone dressings. The entrance for the mailcarts and mail staffs is from the Strand. The mails will be driven in and unloaded under the shelter of a glass roof, on to a platform level with the sorting office. Entering the building from the main doorway, the public business room is on the right hand side of the vestibule, and is furnished with the customary clerks' counters and tables for the public. To the left of the vestibule are the respective private offices of the postmaster and chief clerk. The sorting-room is 132 ft. by 36 ft. On the first floor are rooms for the engineer, and a telephone-room. Opening out of the instrument-room are the superintendent's room, lavatories, &c. On the second floor there are the female clerks' retiring-room, lavatories, a dining-room for the benefit of the staff generally, and a kitchen. On the top floor are a gymnasium, a recreation or music-room, and a messengers' waiting-room. The contract for the erection of the new building was originally given to Messrs. David Jenkins & Co., but the work has been finished by the Government's clerk of works.

NEW BUILDINGS IN ABERDEEN.—The Plans Committee of Aberdeen Town Council report having sanctioned the following plans:—Additions in connexion with the Royal Lunatic Asylum, Berryden-road, per Mr. George Taylor, clerk of works; two dwelling-houses and shop on the west side of King-street at its junction with School-road, for Mr. John Adams, per Mr. William Ruxton, architect; alterations in connexion with premises on the west side of Commerce-street, for Messrs. Brown & Robb, per Messrs. Brown & Watt, architects; alterations in connexion with shop front at No. 83, Union-street, for Salmon & Gluckstein, Ltd.; alterations in connexion with shop front at No. 96, Union-street, for Miss Walker, Forsyth Hotel, per Messrs. Brown & Watt, architects; alterations and additions in connexion with bakery on south side of Queen-street, for Mr. Thomas Mitchell, baker, per Mr. R. G. Wilson, architect; fish-curing premises on the west side of North Esplanade, for the Scottish Co-operative Wholesale Society, Ltd., per Mr. James Davidson, architect, Glasgow. The Committee had also before them plans of two dwelling-houses on the east side of Sunnyside-road, for Mr. Charles Aden and Mr. William Petrie, per Mr. James Brown, builder; dwelling-house on the north side of Bedford-place, for Mr. Joseph Shirras, builder; two dwelling-houses on the west side of Forest-avenue, for Mrs. Lewis, per Mr. William Smith, architect; two dwelling-houses on the west side of Blenheim-place, for Mr. Alexander Robson, engineer, and Mr. George Robson, manager, Ceylon, per Mr. John Milne, architect. The Committee approved of these respective plans.

RESTORATION OF BRECHIN CATHEDRAL.—The restoration of Brechin Cathedral may now be regarded as an accomplished fact. The object of the recent scheme was, "while conserving what still exists of the ancient fabric, to bring back by a judicious restoration as much as possible of its pristine beauty." When the plaster ceiling was taken away it was found that the clearstory remained uninjured. Stone coffins were disclosed, and there were found the foundations of what had evidently formed a Norman building on the site of the present cathedral. The chancel had suffered least from the ruthless destruction of time and Vandal. It was a very beautiful and delicate piece of work of Early English pattern, and the fragment that remained has enabled the architects to continue the design through the restored part. The chancel is a thirteenth century one, coeval, of course, with the building of the cathedral. The composition of the windows is repeated; the roof is of oak, embellished with carvings; and the stone used is the same as that of the original construction. A porch dignifies the principal entrance on the north side. Doors for egress are provided, one from the new north aisle and one from the south transept, in addition to the great western door, which has been left intact. As there was little left to guide the architect in the restoration of the aisles, this involved a fresh design. The outside walls have been brought down to their proper height and roofed over, and the entire result brings into fine relief the famous round tower. Mr Campbell contributed the expense of the organ case, made of Karri pine; a native of Brechin filled all the windows of the choir with stained glass, and in the chancel there are fourteen memorial windows. Other windows include one erected by public subscription to the memory of the late Rev. John A. Clark; another by the family of Shiress Will, of Ardovie. The Communion table, made of fine oak, with Gothic carving, was the gift of the Women's Guild of the congregation. So was the pulpit of oak, with cusps and canopied niches and figures. It stands at the south respond of the chancel. On the north respond is a large Corennie granite font, the gift of the Rev. William Duke, of St. Vigeans. The architects were Messrs. John Honeyman, R.S.A., and Keppie.—*Dundee Courier.*

WESLEYAN SUNDAY SCHOOLS, ILFORD.—The memorial stones were recently laid of the new Sunday school and church premises in course of erection at the rear of the Wesleyan Church, High-road, Ilford. The building, which is to cost about 3,000*l.*, will have accommodation for 550 adults, and will consist of a classroom, 50 ft. by 40 ft., and an infants' class room, 17 ft. by 20 ft. There will be a church parlour and other rooms on the first floor. The building is of bricks, with bath stone dressings, and will be about 30 ft. high. The interior will be lighted by gas, and heated with Grundy's patent hot air system. The architects are Messrs. Gordon & Gunton, and the builders Messrs. E. A. Roome & Co.

FACTORY, BRISTOL.—A new boot factory is being built to the order of Messrs. Parsons & Co., boot and shoe manufacturers, at Gerrish-avenue, a part of the Whitehall Estate, St. George. The new factory, when complete, will be 200 ft. by 120 ft., and the basement story will cover an area of 115 ft. by 60 ft. The premises, when complete, will be lighted with the electric light, and the heating of the factory will be by hot-water (low pressure). The flooring will be of granolithic, and the latest type of machinery will be erected in the new factory. The architect is Mr. John Mackay, of Kingswood, and the builder is Mr. Fred. Brown, of Easton.

COUNTY COUNCIL OFFICES, DUBLIN. — The building known for several years as the National Club in Rutland-square, having been acquired by the Dublin County Council, has been remodelled for the use of the County Council. The building has been remodelled by Messrs. J. & W. Good, builders, Dublin, according to plans prepared by Mr. W. Collon, C.E., County Surveyor. The painting has been done by Messrs. W. Martin, Son, & Co., and the panelling of the walls and the parquet flooring by Messrs. Goodall & Co., of Manchester. The Council chamber, committee-room, and secretary's office are furnished in Austrian oak.

GYMNASIUM AND INSTITUTE, CAMELON, STIRLING. —A new building for the Camelon Institute has been erected in Union-road. The accommodation comprises gymnasium, dressing-room, bathrooms, reading and committee rooms, recreation or billiard room, stores, caretaker's house, &c. The gymnasium is about 50 ft. long by 30 ft. wide, is lighted from the front by four windows, and also by four rooflights. It may also be used as a concert hall when required, a temporary platform being fitted up at one end. The dressing-room opens off at the west end of the gymasium, but has a separate entrance from the side street on the north. A set of lockers is arranged along one wall for the use of the members. At the south end are two bathrooms. The reading and committee rooms are on the north side of the gymnasium, and have communication with the gymnasium. The billiard-room on the first floor is suitable for two full-sized tables. The front to Union-road is built with Ballochmyle red stone and the other portions with red bricks, and the architects are Messrs. Robert Keith & Son, Dundee, and the contractors as follows:—Mr. R. Dalziel, mason; Messrs. Gilchrist & Packman, joiners; Mr. John Smith, plumber; Mr. James Millar, plasterer and slater—all of Falkirk; Messrs. G. H. Nicoll & Co., Dundee, heating engineers; and Messrs. Cousland & Mackay, Glasgow, ventilating engineers.

ORANGE HALL, BALLYMACARRET, BELFAST.—This building, which will be four stories in height, is nearing completion. On the ground floor there will be four shops—two on each side of the main entrance corridor. At the end of the corridor, stairs on both sides will rise to the landing place on the first floor, from which access will be had to two lodge-rooms 30 by 20 ft., and in case of necessity these two rooms can be thrown into one by the withdrawal of a folding door. It is estimated that this room will then give accommodation for meeting purposes to about 500 persons. The second floor will be similarly arranged, and on the third floor there will be several lodge-rooms, store-room, &c. The design, plans, and specifications were prepared by Mr. Cooper, architect (now of Dublin), and estimates for the erection of the building having been completed, the contract was secured by Mr. K. G. Walker at 3,300*l.* The work is now under the immediate superintendence of Mr. Henry Seaver, architect, Belfast.

NEW BUILDINGS IN ABERDEEN. — At a meeting of the Plans Committee of the Aberdeen Town Council on the 12th inst., fourteen sets of plans, including thirteen new dwelling-houses, were submitted. The only item of a public nature was a plan for additions to Rosemount Public School, comprising increased classroom accommodation, rooms for cookery, and manual instruction, &c., at a cost of 7,000*l.* The total amount involved in the plans submitted to the meeting was about 20,000*l.*

ST. ANDREW'S CHURCH IMPROVEMENTS, BRAEMAR.—In pursuance of the improvements going on in St. Andrew's Church, Braemar, the vestibule of the church has been laid in mosaic. In the centre of the floor is a full-length figure of St. Andrew, the patron saint of Scotland and of the church, with his distinctive cross, and holding in his hand the book of the gospels. The border of the design is made up of the thistle of Scotland and leaves. The original idea of the design was supplied by Canon Paul, the pastor of the church, and was wrought up by Messrs. Minton, Hollins, & Co., Stoke-upon-Trent, who executed the whole work. The work of laying the floor was entrusted to Messrs. Rodger & Baxter, of Aberdeen.—*Aberdeen Journal.*

SANITARY AND ENGINEERING NEWS.

DRAINAGE SCHEME FOR WALSALL.—On the 3rd inst., at Walsall Guildhall, Colonel W. R. Slacke held an inquiry on behalf of the Local Government Board into an application by the Town Council for sanction to a loan of 1,800*l.* for surface drainage works. The Town Clerk (Mr. J. R. Cooper) explained that it had been found that the sewers in the borough were not large enough to carry off the water which ran into them whenever there was a storm, and this had led to flooding in some of the lower parts of the town, which had occasioned great inconvenience. There were also difficulties in the way of dealing with it at the sewage farm. A scheme for laying a complete system of surface water throughout the borough had been prepared by the Borough Surveyor, the town being divided into fifteen districts. The estimated cost of the whole scheme was upwards of 23,000*l.*, but the Council decided to carry out the work in instalments.—The Borough Surveyor (Mr. R. H. Middleton) having given details of the work to be carried out, the inquiry terminated.

ABERDEEN HARBOUR WORKS.—A new entrance to the Upper Docks has been constructed at Aberdeen, and the old Regent Bridge, over the tidal harbour at the foot of Marischal-street, which, with the growth of trade and the development of the Upper Dock, not only had become unsuitable for shipping, but inadequate for the pedestrian and vehicular traffic, is being reconstructed. The new bridge will be built entirely of steel, and will be able to carry two locomotives, with trains, vehicles, and a crowd of people. The new passage which it spans will be 67 ft. wide, or 20 ft. wider than the passage opened for traffic on the 11th inst., which is only part of the new entrance; but the position has been shifted considerably south of the old passage in order to lead shipping more into the centre of the Upper Dock, and give protection to the vessels lying at the quays. The new bridge has abutments or piers of masonry founded on cylinders, on which it rests, and the south abutment is permanently completed and forms the south boundary of the new passage. The north abutment will be constructed within the cofferdam, which at present forms the north boundary of the new passage. As the Commissioners decided that the cross traffic should be carried on with the least possible interruption during the reconstruction, a temporary bridge had to be provided, and, seeing that the shipping traffic had to be transferred at a certain stage to the new entrance, it was necessary to provide an opening in the temporary bridge in line with the new entrance to let the shipping through. This has been accomplished by a bascule bridge, which is a light structure built entirely of steel. It has two leaves, which open in a vertical plane by revolving on axles or pivots carried in bearings on pilework. The width of the bridge is 14 ft. over all, made up of a carriageway 8 ft. wide and two pavements about 3 ft. wide. At the opening of the bascule bridge on the 11th inst., there were present Captain Crombie, harbour master; Mr. R. Gordon Nicol, C.E., harbour engineer; Mr. A. Simpson, assistant engineer, and others.

LONGTOWN WATER SUPPLY.—Having got the sanction of the Local Government Board to a scheme devised by Mr. John Little, of Carlisle, for the supply of the two parishes of Arthuret (including Longtown) and Kirkandrews-on-Esk, at an estimated cost of 17,000*l.*, the District Council have decided to enter into a contract with Messrs. Drummond & Sons, Dumfries, for the work to be carried out at a cost of 10,317*l.* 13s. 6d. There were sixteen tenders considered by the Council.

MISCELLANEOUS.

PROFESSIONAL AND BUSINESS.—Messrs Davis & Emanuel, architects, of 2, Finsbury-circus, have taken into partnership, as from the 1st January next, Mr. H. C. Smart, who has been in their office for fifteen years. The title of the firm will remain unaltered.——Mr. Charles E. Hawkins, who has served thirty-two years on the Government Geological Survey, has now retired, and intends to devote his whole time to private practice as a consulting geologist.

SPRAGUE'S POCKET DIARIES.—We have received from Messrs. Sprague & Co. their Pocket Diary and

Architect's and Surveyor's Memorandum Book for 1902. On the usefulness of this small diary, and the tables of statistics bound with it, we have often spoken. They send us also a general pocket diary and memorandum book in another form the pocket-book forming a tolerably large leather purse or letter-case, with the diary inserted in one of the pockets.

SALE OF A LIBRARY.—Messrs. Sotheby, Wilkinson, & Hodge, held their last book sale of the season at their rooms in Wellington-street, Strand, on December 17, 18, and 19, when the catalogue included several hundred volumes from the library of the Royal Archæological Institute. The following were some of the prices realised :—"Monumental Effigies of Great Britain," by W. A. Stothard, 1817, 2*l.* 16*s.*; "The Principles of Gothic Ecclesiastical Architecture," by M. H. Bloxham, three volumes, 1882, 13*s.*; "Mediæval Military Architecture of England," by G. T. Clark, two volumes, 1884, 14*s.*; "Glossary of Terms used in Architecture," by J. H. Parker, 1850, 2*l.*; "On the Styles of Architecture in England from the Conquest to the Reformation," by T. Rickman, 1881, 1*l.* 13*s.*; "Some Account of Domestic Architecture in England," by T. H. Stone, 1851-3, 2*l.* 12*s.*; "Miscellaneous Tracts Relating to Antiquity," published by the Society of Antiquaries, 1770-1900, 16*l.*; "The Decorative Arts, Eccesiastical and Civil, of the Middle Ages," by H. Shaw, coloured plates and illustrations, 1851, 1*l.* 6*s.*; "Horæ Ferales, or Studies in the Archæology of the Northern Nations," by J. M. Kemble, edited by Latham and Franks, numerous plates, 1863, 1*l.* 16*s.*; "The Monumental Effigies, Ancient Stone and Leaden Coffins, Tiles, &c., in the Temple Church," two volumes, plates, 1843-5, 9*s.*; "Incised Markings on Stone, found in Northumberland, Argyleshire, and other places by the direction of the Duke of Northumberland," by Rev. J. C. Bruce, 1869, 1*l.* 9*s.*

THE INCORPORATED CHURCH BUILDING SOCIETY.—This Society held its usual monthly meeting on Thursday the 19th inst. at the Society's house, 7, Dean's-yard, Westminster Abbey, S.W., the Rev. Canon C. F. Norman in the chair. Grants of money were made in aid of the following objects, viz.:—Building new churches at Pockthorpe, Emmanuel, near Norwich, 70*l.*; St. Marylebone, St. Cyprian, Middlesex, 250*l.*; and Sandiway, St. John the Evangelist, near Northwich, Chester, 65*l.*; and towards enlarging or otherwise improving the accommodation in the churches at Ashton, St. John the Evangelist, near Chudleigh, Devon, 25*l.*; Milford Haven, St. Catherine, Pembroke, 60*l.*; St. Columb Major, St. Columba, Cornwall, 35*l.*; Wembworthy, St. Michael, Devon, 15*l.*; and Radley, St. James, near, Abingdon, Berks, 30*l.*; in lieu of former grant of 20*l.* Grants were also made from the special Mission Buildings Fund totowards building Mission Churches at Preston, St. Matthias, near Brighton, 20*l.*; and West Bromwich, the Good Shepherd, Staffordshire, 25*l.* The following grants were also paid for works completed :—Forest Gate, St. Edmund, Essex, 150*l.* on account of a grant of 250*l*; Cardiff, St. Teilo, 300*l.*; Hoo, All Hallows, near Rochester, 10*l.*; Eastcombe Mission Church, near Stroud, Gloucester, 15*l.*; Churwell Mission Church, near Dewsbury, 25*l.*; Cowper Quay Mission Church, near Blyth, Northumberland, 20*l.*; and Steelworks Mission Church, near Ebbw Vale, Monmouth, 20*l.* In addition to this the sum of 257*l.* was paid towards the repairs of twelve churches from trust funds held by the society.

THE ELEVATIONS OF BUILDINGS AT BELFAST.—A deputation waited upon the Belfast County Council recently in order to state their objections to the clause making it compulsory that drawings showing the elevations of buildings overlooking any street in which it is proposed to erect or alter any building, as well as the height, character, and design of the proposed building and of any adjoining buildings should be supplied to the City Surveyor. The clause states that any person aggrieved by a decision of the surveyor may appeal to the Recorder of the city, whose decision shall be final. The deputation consisted of the following:—Messrs. W. J. Gilliland, W. J. Fennell, W. B. Fennell, N. Fitzsimons, A. T. Jackson, J. St. J. Phillips, and W. B. Blackwood. Mr. Gilliland said he represented the Ulster Society of Architects, and through them the profession in Belfast. The proposed clause was objected to, and the alterations made had not improved matters, but rather the reverse. The City Surveyor was constituted the censor for Belfast in architectural matters, a position which they as architects thought no City Surveyor should occupy. There should be by-laws to assist him in forming his opinion. It might often be very difficult to supply the particulars demanded in regard to neighbouring buildings, the owners of which might be at daggers drawn with the person erecting the new building. The appeal to the Recorder was an illusory form of appeal, being simply an appeal from an opinion, and all arguments would simply leave the matter where it was originally. He hoped they were all working to improve the architectural character of the streets of Belfast, and they again tendered their assistance publicly to the Corporation to help them in framing a clause having this object in view; but they objected to the possibility of an architect's design being vetoed on the mere opinion of the City Surveyor. Mr. W. J. Fennell said they had made a wise regulation as to the thickness of the walls of the buildings in the city, and they ought to have a similar clause as to the height of buildings in ratio to the width of the streets. They objected to the City Surveyor saying, "Thus far and no further," although they did not think Mr. Bretland would take a vexatious view of the clause. The Lord Mayor asked if the deputation had prepared a clause in substitution for the one they objected to. Mr. Gilliland answered in the negative. The Lord Mayor said in case of appeal, the Recorder would hear the evidence and act upon it. The deputation then retired.

ARCHITECTURAL SHAMS.—Mr. E. R. Taylor, head master of the Birmingham School of Art, distributed the prizes at Brightelmston School, Birkdale Park, Southport, on the 14th inst. In his address Mr Taylor spoke of the value of drawing as a part of education. They learned to draw because it was a help to other studies, and another reason was that they might help to lessen the ugliness of to-day. Until about a century ago, he said, all things made by man, from buildings to articles for kitchen use, had in them some element of beauty and fitness, and generally so much of rightness and beauty that the former could not be pulled down without protest, and the latter were gathered into museums. Looking at the two extremes of each, they must admit there were distinct lines of demarcation between beauty and ugliness. In architecture the manor houses and cottages on the Cotswolds, or the half-timber work of Cheshire and Warwickshire, were things of beauty, and in contrast to most of the modern mansions and workmen's cottages. If they admitted that beauty and ugliness were not convertible terms, it was worth while to inquire into the cause of so much of the present-day ugliness. If they looked at Turkey, India, and Japan they would find that good work continued to be produced in these countries until recently. The work, however, was now contaminated by modern European influences, the same influences which had made our work in this country bad. Japan was the most recent and lamentable instance. It had hurried to adopt western ideas of life, and its exhibit at the Glasgow Exhibition was the most melancholy sight there. One cause of this present-day ugliness was the attempt to revive old styles. The notion that we could bring to life dead styles was a misuse of the study of history, and yet it still prevailed. Another cause of bad work was the love of shams—not toleration only, but a real love of shams. When he began work in Birmingham, students and others on showing him their work generally reached the climax of praise by stating it was like something it was not. As an instance of this he cited the treatment of a rubble wall which had a beauty of its own with its irregular mortar joints, which gave a texture to secure which in other things great expense was often incurred. This was spoiled by ruling straight mortar joints at all angles to make it less like rubble work. A final cause affecting all the others was the judgment by money value. This tainted all their work. In closing, he advised them in their pursuit of beauty to study simple and right construction, to study old work to see how it grew, to love nature, the source of all that was beautiful, and to live simply.

FLORENTIAN INDUSTRIES.—In a special report recently made to the Foreign Office by Mr. Percy Chapman, British Consul-General, on the industries of the province of Florence, it is stated that the Florentine mosaic (hard stones) industry, quite a speciality, once enjoying a world-wide renown, is now greatly affected by the competition of inferior mosaics of softer stones, as well as by fashion. The important Government works for hard stones-giving employment to twenty-one men, are, how, ever, still in existence. It is calculated that this industry gives employment to 150 hands, including some children under fifteen years. The working of ornamental stones, and especially of Carrara marble and serpentine (*verde di Prato*) holds a considerable place amongst the industries of the province. The working of marble and alabaster into statues and statuettes of an industrial type likewise occupies a considerable number of workmen, partly working at their masters' studios and partly at their own homes. The approximate number of workmen can be no less than 535. This industry, like mosaics, is almost exclusively supported by British and American demand. Of stone quarries there are 202 in actual work in the province, of which four are serpentine (*verde di Prato*), five calcareous stone (*alberese*), two grindstone (*enfotide* or *granitone*), five fireproof stone, three calcareous tuff, 170 "arenaria" (hard grey stone for olive presses), eleven building stone (*pietra forte*), and two majolica earth. The serpentine (*verde di Prato*) serves for architectural and ornamental purposes. These quarries, situated at Monferrato, near Prato, have been worked from a very early date. In 1365 they were taken on lease by the Opera del Duomo to employ the stone in ornamental works on the Cathedral. At present they are in the hands of two private persons, and their output (valued at 1,000*l.* per annum) is almost entirely used in Florence, partly for repairs to the Cathedral and other churches of the city, and partly in making statuettes, bowls, vases, and other ornamental objects. With regard to the calcareous stone (*alberese*), some is cut into flags for street paving, and the remainder is employed in masonry in its original state, or else reduced into chippings and utilised in the metalling of roads. The average output of these quarries may be calculated at about 3,200*l.* per annum. The tuff is utilised as a very common building stone, the greater part being reduced into gravel. The arenaria stone, including the varieties of "macigno" and "pietra forte," enjoys an excellent reputation as a first-class architectural and building stone; the largest output is obtained at Fiesole, Carmignano, Lastra a Signa, and Galluzzo. The Fiesole quarries alone give an approximate annual output of 10,400*l.* The total number of quarries is 1,300. This stone is frequently used outside Tuscany and even exported abroad.

ARBITRATION CASE.—Mr. G. F. Deacon, C.E. the arbitrator appointed to determine the dispute between Messrs. Holme & King and the Merthyr Urban District Council in connexion with the construction of the new reservoir at Upper Neuadd, has issued his award. Messrs. Holme & King in 1875 contracted with the Council to do certain work at the new reservoir, the contract upon a schedule of prices being estimated to amount to about 77,000*l.* They were to quarry the stone and deliver it on the works, and to supply the cement and lime necessary for making the concrete in which the masonry was to be set, the setting of the masonry to be done by men employed on behalf of the Council. The contract was to have been concluded in three years, but there were difficulties in the way of completion within the stipulated term, and the period was extended. The work still lagged, and from time to time the contractors sent in continuously increasing claims to the Council for damages for delay, caused, as they alleged, by their men being kept idle and unable to go on with their work, consequent upon the Council's men not carrying out expeditiously their portion of the undertaking. Eventually the position became so strained that in June last the contractors were relieved of their contract. Messrs. Holme & King then brought up their claim to no less than 37,000*l.* The Council declined to pay, and so the matter under the contract was referred to Mr. Deacon, the consulting engineer, who took evidence in London. The proceedings extended over a month, Mr. Joseph Shaw, K.C., appearing for the Council, and Mr. Leyton, Liverpool, for the contractors. The amount of the award is 2,036*l.*, each side to pay their own costs.—*Western Mail.*

STRAND IMPROVEMENT AWARD.—On the 19th inst. Mr. John Troutbeck, High Bailiff for Westminster, and a special jury sat at the Surveyors' Institution, Westminster, to assess the amount of compensation to be paid by the London County Council to Mr. W. H. Collingridge, of Aldersgate-street, City, for the freehold premises, 17 and 18, Wych-street, Strand, compulsorily acquired for the purposes of the Strand improvement scheme. The jury awarded the claimant 11,084*l.*, including everything. The High Bailiff decided that the claimant had not lodged full particulars of his claim within a reasonable time, so as to allow the Council to make him a proper offer, contrary to Section 12 of the Act. The effect of this was that the claimant pays all his own costs and half the cost of the inquiry.

NEWCASTLE BUILDING TRADE ASSOCIATION.—The annual dinner of the Newcastle, Gateshead, and Tyne District Building Trade Employers' Association was held on the 18th inst. at the County Hotel, Newcastle. The chair was occupied by Mr Walter Lowry, and the vice-chair by Mr. Alex. Pringle. After the loyal toasts, Mr. W. T. Weir proposed the "Mayors and Corporations of Newcastle and Gateshead." The Mayor of Newcastle, in responding, said careful observers must notice that a great transformation was taking place in Newcastle. If the Corporation was encouraged by having the confidence of the ratepayers, Newcastle ere long would be opened out in various directions. Its heart would he extended and its suburbs developed. The main thoroughfares in the heart of the city were too narrow and too few. They required duplicating. He hoped that before long not only would Grey-street be carried up to the Hay Market, but that they should have a great thoroughfare uniting the vast population of Heaton with that of Arthur's Hill. He hoped the Corporation would have sufficient intelligence to secure Singleton House property as a future home for the municipal buildings. If the purchase was delayed, instead of costing 120,000*l.* or 140,000*l.*, it might cost them twenty years hence 300,000*l.* Referring to the electric tramways, he said they were putting the cars on the rails as soon as the manufacturers could let them have them. In six months probably they would be fully equipped, and have a two or two and a half minutes' service in the principal thoroughfares. The Mayor of Gateshead also responded. Alderman D. Ranken, Sunderland (President of the Northern Counties Federation), proposed the "Newcastle, Gateshead, and Tyne District Branch of the Northern Counties Federation of Building Trade Employers." He spoke of the unity displayed in Newcastle by members of the building trade, when they held out for nine months against what they believed to be the unfair and unjust demands of the workmen. There were still some firms outside the Building Association whom he thought should throw in their lot with the Federation. He also suggested the advisa-

bility of getting the foremen to join the employers' society. So long as the foremen remained members of the men's society they would not, as employers, secure the full measure of assistance in carrying out their work which they ought to have. He alluded to the recent articles in the *Times* newspaper and other publications as to the limitation of work on the part of the men. He trusted one effect of the exposure would be that in future the men would do a fair day's work for a fair day's wage. The President (Mr. Walter Lowry), who responded, was received with musical honours. He spoke of the very large number of bankruptcies which there had been in the building trade throughout the past year. There were two reasons why they occupied this unfortunate position. The first reason was that people entered the building trade with too little capital, and the second reason was that they did not know the proper prices to put down to cover the work they had to do. Referring to the subject of the restriction of output, as mentioned by Alderman Ranken, he said the doctrine that if three men did the work of two it would make employment for another man was a foolish argument, which could only rebound on the heads of those who made it. They had seen the finish during the year of one of the most disastrous strikes known in the building trade for a long time. It was an extraordinary thing that a body of men should have the power to dislocate the whole trade throughout the North of England for nine months. He hoped the time was not far distant when some other method would be established for settling disputes. He felt hopeful that in the future conciliation would play an important part, and he instanced the success of the Conciliation Act in New Zealand.

SOUTH WALES BUILDING TRADES FEDERATION.—A meeting of this Federation was held at the Master Builders' rooms, 10, Dynevor-place, Swansea, the President, Mr. W. Thomas (Cardiff) presiding. Letters were read with reference to the Foremen's Association. It was resolved that the secretaries of the various associations affiliated should be written to for a complete return of their members, together with the amount of wages paid by each member during the last twelve months, this return to be sent in by the last week of January or the first week of February. In accordance with the resolution passed at the previous meeting held at Cardiff, the Swansea delegates submitted the draft of the new rules which this Association had drawn up, and intended offering the Plasterers' Society in May next. After a long discussion they were eventually approved of, subject to a few alterations, and certain power was given the Swansea Association for dealing with same. It was resolved to adopt the crest submitted by the National Association, and that each association affiliated with this Federation be advised to obtain one. Resolved that the next meeting be held at Newport about the first week of March, date to be arranged by the President and secretary.

LEGAL.

BRADFORD ARCHITECT'S CLAIM.

AT the West Riding Assizes, Leeds Town Hall, on the 18th inst., before Mr. Justice Ridley, an action was brought by Mr. Wilson Bailey, architect, of Bradford and Keighley, to recover 171*l.* 3s. from Mr. James Longton, schoolmaster, of Keighley, for services rendered. The defendant had paid 87*l.* 18s. 11d. to the plaintiff, and brought into court a further sum of 5*l.* 4s. 6d., which sums, he contended, were sufficient to satisfy the claim. Mr. Scott Fox, K.C., and Mr. Waugh appeared for the plaintiff; and Mr. E. Tindal Atkinson, K.C., and Mr. Compston defended.

In opening the case, Mr. Waugh said that the claim was for services rendered in respect of the preparation of plans, the getting out of quantities, and the obtaining of tenders for certain houses which the defendant contemplated building in Highfield-lane, Keighley. The defendant's intention at first was to build seven houses on the back portion of the land. The plaintiff prepared plans for these, and then the defendant said he would build five houses on the front portion. The defendant instructed the plaintiff to put all the sculleries on the left-hand side of the houses, and then he had the sculleries of the first and third houses reversed, which necessitated fresh plans. The plaintiff then obtained tenders from builders for the erection of these houses. Later the defendant decided to have fresh plans prepared with the sculleries inside the houses. The defendant continued to change his mind, and finally decided not to build. The defendant set up in defence an agreement in writing, dated January 7, 1898, alleging that in this the plaintiff estimated the cost of the buildings at 2,250*l.* 10s., that when the tenders were obtained they amounted to 3,206*l.*, and that by reason of that fact the services became wholly worthless. The defendant further said that the plaintiff did not prepare a second set nor obtain further tenders, or if he did the cost was 3,100*l.*, which was far more than the estimate.

Mr. Compston intimated that liability was not denied, the sole question being as to the amount which the plaintiff was entitled to.

Mr. W. J. Morley, architect, Bradford, said that he considered the plaintiff's charges for the work were low. The Institute's charges would have been about 300*l.* Mr. Sugden, architect, Keighley, said that his charges for the same work would have been over 200*l.*

Called on behalf of the defendant, Mr. John Connon, architect, Leeds, declared that a fair remuneration for the work done would be about 93*l.*; and Mr. Charles France, architect, Bradford, said that he thought the amount the defendant had paid into court, 92*l.* 6s. 5d., was reasonable remuneration.

The defendant said that in 1887 Mr. Bailey had built for him a number of houses on the Highfield-lane plot. He intended building other houses on the same plot in 1898, and entered into an agreement with Mr. Bailey for the preparation of plans at 5 per cent. on the cost of the houses. He had every wish to pay the plaintiff fairly for the work he had done.

His Lordship found for the plaintiff for the amount claimed, holding that there was no agreement in regard to the cost of the houses.—*Yorkshire Post.*

ALLEGATIONS AGAINST BIRMINGHAM ARCHITECTS.

AT the Birmingham Assizes last week, before Mr. Justice Kennedy and a special jury, the case of Forbes and Charles *v.* Lloyd was concluded. Mr. Hugo Young, K.C., and Mr. McCardie appeared for the plaintiffs; and Mr. A. T. Lawrence, K.C., and Mr. Stubbins for the defendant. The plaintiff Charles was a builder, and Forbes and the defendant were architects, and the action was brought to recover damages for libel. The statement of claim alleged that before the month of May, 1900, the plaintiffs prepared ground plans for the erection of an arcade and theatre upon the site of the Theatre Royal, and a description of the plans was published in the *Daily Argus* on October 4, 1901. On October 8 the defendant, in a letter to Mr. F. S. Bolton, falsely and maliciously wrote and published of the plaintiffs, *inter alia*, the words following:—"Your architect and builder have practically appropriated in its entirety my scheme." And on October 15 the defendant wrote to the editor of the *Birmingham Daily Mail*, and caused to be published in the issue of that paper of that date a letter repeating the accusation in different terms. The defence was simply a denial of the matters alleged. It appeared that some time before the defendant prepared plans and submitted them to certain gentlemen who were endeavouring to form a syndicate to acquire the site in question, which, however, was ultimately secured by Mr. Bolton, who employed the plaintiffs as builder and architect, and they prepared ground plans, and published them as stated. Before their publication the defendant saw the plaintiff Charles, and tried to get plaintiffs to purchase his plans for 100 gs., and to have him appointed as architect, but they did not fall in with these proposals. The defendant, in his evidence, reasserted his belief that the plaintiffs had appropriated his ideas. He was also allowed to give evidence in mitigation of damages as to the alleged close resemblance of the two plans. The plaintiffs denied on oath that they had seen the defendant's plan at all before they prepared their own. The jury found for the plaintiffs; damages, 50*l.* to Charles and 25*l.* to Forbes.

LAVATORY ACCOMMODATION.

AT Lambeth Police-court, on the 19th inst., the South-Eastern and Chatham Railway Company were summoned, at the instance of Mr. J. S Pointon, a sanitary inspector in the service of the Camberwell Borough Council, to answer the complaint that there was an insufficiency of lavatory accommodation at their station at Nunhead, Mr. G. W. Marsden, solicitor to the council, supported the summons on their behalf and said the proceedings were instituted under Section 37 of the Public Health (London) Act. Nunhead Junction was a station at which a very large traffic was done. There were 1,000 season-ticket holders, and in addition the station staff and a number of coal porters working at the adjacent coal siding had to be accommodated. The council were of opinion that the lavatory accommodation provided was insufficient, and they had been in communication with the company, who had, however, absolutely refused to provide any further accommodation. He submitted that the station was a "building or house" within the meaning of the section. Mr. Alexander Glen, who appeared for the company, said the main question that arose in this case was whether the provisions of the statute in question applied to a railway station which was erected under the powers of a special Act of Parliament. Inspector Pointon and Dr. Stevens, Medical Officer of Health for Camberwell, having given evidence in support of the summons, Mr. Glen pointed out that the notice served by the Council was in general terms and did not say what accommodation was necessary. Mr. Francis: Do you want this case to go off upon a technicality or are you prepared to do anything? Mr. Glen said he took the point that the notice was not sufficient, and he also took the more important point that the station was built in pursuance of the special Acts of the railway company, and that the Act under which these proceedings were taken did not apply. Mr. Francis.—In other words, you say I have no jurisdiction in this matter. Mr. Glen.—In the first place, that the Local Authority have no jurisdiction, and that, therefore, it follows that they have no power to enforce compliance with their requirements in this court. In the course of some further discussion, Mr. Glen mentioned that the company contemplated rebuilding the station, and, consequently, did not want to go to any large expense in regard to the present structure. Eventually the further hearing of the case was adjourned for a fortnight, with a view to an arrangement between the Council and the company.—*Times.*

ANCIENT LIGHT DISPUTE IN FINSBURY

MANDATORY INJUNCTION AGAINST A BUILDER.

THE case of the Home and Colonial Stores *v.* Colls came before the Court of Appeal, composed of Lords Justices Vaughan Williams, Romer, and Cozens-Hardy, on the 20th inst. for judgment on the appeal of the plaintiffs from an order of Mr. Justice Joyce in the Chancery Division on December 20, 1900. The case was fully reported in the *Builder* of December 8 and 29, 1900.

The facts were shortly these:—The plaintiffs are an incorporated company having a number of shops in different parts of the country, and brought the present action to restrain the defendant from erecting a proposed building so as to obstruct the plaintiffs' ancient lights. The premises in question were the head offices of the plaintiffs, situate in Worship-street, City. The plaintiffs' building was situated at the corner of Paul-street and Worship-street, but the only part concerned in the action was the Worship-street frontage. The plaintiffs were lessees of the premises from the Ecclesiastical Commissioners. The defendant was a builder, and also lessee of premises which he was erecting on the opposite side of the road, which was about 41 ft. wide. The premises which formerly stood on the site were 19 ft. 6 in. in height, and the defendant proposed to erect a building to a height of 42 ft., which the plaintiffs said would obstruct their lights. The main question to be decided was as to the apprehended injury to the light coming to the windows on the ground floor of the plaintiffs' premises, the portion of the ground floor opposite the defendant's premises being used as an office. It consisted of a large room 11 ft. 10 in. high and of unusual depth, the back wall being upwards of 50 ft. from the Worship-street front, and it had no window nor source of natural light at the back. This room, which was used by clerks in the plaintiffs' employ, was fitted with electric light, and the result of the evidence given at the trial was that it was the custom to use the electric light in the back part of the room on most days. The windows on the ground floor were of large size, the uppermost part of each window being filled with coloured glass to a depth of 20 in. from the top, and there were wire blinds fixed at the bottom of each window. At the trial a great amount of expert evidence was given, and it was practically admitted by the plaintiffs' witnesses that the defendant's building might be raised to a height of 25 ft. from the ground without any material injury to the plaintiffs. Mr. Justice Joyce was of opinion that there was no evidence to show that any extraordinary amount of light from the Worship-street windows had been enjoyed for anything like the twenty years, and that the proposed new building of the defendant would not affect the selling or letting value of the plaintiffs' premises. He said that if erected to the proposed height of 42 ft. no part of the defendant's building would be high enough to reach any line drawn at an angle of 45 deg. to the horizon from any point in the base or sill of either of the windows in question belonging to the plaintiffs. But he thought the defendant's building would for its width of 30 ft. directly south of these windows cut off a portion of the sky area then visible from within the plaintiffs' office, and would, he thought, to some extent necessitate the more frequent use of artificial light in the front part of the office. Apart from any question with respect to the back part of the plaintiffs' premises and to the extraordinary amount of light required therefor in the absence of illumination by artificial light, the plaintiffs' premises would still, in his lordship's opinion, after the erection of the defendant's building be well and sufficiently lighted for all ordinary purposes of occupancy as a place of business. In his lordship's opinion, the plaintiffs' premises were unusually well lighted. If, however, as the plaintiffs contended, they were always entitled to the full amount of light they then enjoyed, they would have a good cause of action, although it might be doubted whether the diminution of light to their building by the defendant's proposed building would entitle them to an injunction. The learned Judge came to the conclusion that he must follow the decision of Mr. Justice Wright in the case of "Warren and others *v.* Brown" (reversed on appeal on the 13th ult. This leading case was reported in the *Builder* of August 11, 1900, and November 2 and 16, 1901) and dismissed the action with costs. Hence the present appeal of the plaintiffs.

Immediately after his Lordship's judgment, the plaintiffs gave notice of appeal, whereupon the

defendant proceeded with the completion of his building.

The arguments on the appeal were heard on December 2 and 3, when their lordships reserved judgment.

Mr. Hughes, K.C., and Mr. W. E. Vernon appeared for the appellants, and Mr. Bray, K.C., and Mr. O. Leigh Clare for the respondent.

Lord Justice Cozens-Hardy read the judgment of the Court, which was to the following effect:—The appeal, he said, raised a question as to the nature and amount of evidence required to entitle a plaintiff to relief by way of injunction for the protection of ancient lights. The action was tried before Mr. Justice Joyce in December, 1900. That was important, because at that date it had been laid down by Mr. Justice Wright, in the case of Warren and others *v.* Brown, that the owner or occupier of a house had no legal right of action so long as he had left to him as much light as is ordinarily required for habitation or business, even though he has been deprived of a substantial amount of light, and has thereby suffered substantial damage. That view of the law was accepted by the defendant's counsel in the cross-examination of the plaintiffs' witnesses and in the examination of the defendant's witnesses, and as the Court read the judgment was adopted by Mr. Justice Joyce. Mr. Justice Wright's decision had recently been reversed by that Court, and the true rule of law with reference to the interference with ancient lights had been authoritatively laid down thus:—"If ancient lights are interfered with substantially, and real damage thereby ensues to tenant or owner, then that tenant or owner is entitled to relief." In this sentence "substantial" did not indicate any particular percentage. In the case of Back *v.* Stacey it was laid down that, in order to give a right of action and sustain the issue, there must be a substantial privation of light, sufficient to render the occupation of the house uncomfortable, and to prevent the plaintiff from carrying on his accustomed business (that of a grocer) on the premises as beneficially as he had formerly done.

Continuing, his lordship said that without substantial interference there was no right of action, and, in addition, in order to obtain an injunction the plaintiff must establish substantial injury, suffered or threatened. There was no standard or fixed amount of light to which alone a plaintiff was entitled. He must not be fanciful or fastidious. He must recognise the necessity of give and take in matters of this nature. But there might be real damage to the owner or occupier of a building used for particular purposes, or reasonably adapted for particular purposes, although there would be no real damage if the building were not used or reasonably adapted for such purposes. The application of these principles was far more easy when the building which was complained of was erected and damages only were claimed, but they had to be applied when the plaintiff came for an injunction before the building had been erected. It was the duty of the Court to arrive at the best conclusion it could upon the effect which the proposed building, if erected, would produce, and if the Court was satisfied that in that event the plaintiff was entitled, as a matter of right, to an injunction to prevent the defendant from interfering with his ancient light, or in other words to restrain the defendant from committing a wrongful act. The difficulty of applying the rule in a *quia timet* action might well induce the Court to scan the plaintiffs' evidence with severity, especially where an angle of 45 deg. was left. It was settled that there was no rule of law that a man might always build up to an angle of 45 deg., but, in judging of the probable effect of a proposed building the Court might not unreasonably regard the fact that an angle of 45 deg. would be left as *prima facie* evidence that there would be no substantial interference, and might require this presumption to be rebutted by satisfactory evidence. That seemed to be the result of the authorities. It remained to apply those general principles to the present case. His lordship then referred to the evidence, and said with regard to the large clerks' room on the ground floor it was impossible to hold that the plaintiffs would not suffer "real damage" if they had to consume and pay for more electric light than hitherto. As this Court read the judgment of Mr. Justice Joyce it was a finding in favour of the plaintiffs that real damage would result, though light enough would be left for ordinary purposes of occupancy as a place of business, and there was no finding that the interference was not substantial. In the opinion of the Court, on the balance of evidence, substantial interference and "real damage" would result; and the proper judgment would have been to grant an injunction in the settled form known as the Yates *v.* Jack form. But immediately after the action was dismissed with costs the plaintiffs gave notice of their intention to appeal. Notwithstanding this the defendant had proceeded with and completed the erection of his building. Under those circumstances there was only one course open to this Court, and that was to reverse the judgment of Mr. Justice Joyce and grant a mandatory injunction requiring the defendant to pull down anything erected in breach of the terms of the injunction, the defendant to pay the costs in that Court and in the Court below.

Lord Justice Vaughan Williams said that he wished to add for himself that, so far as the rule of 45 deg. was concerned, he doubted very much whether that rule, as the law was now settled, could be regarded even as a rough measure of the right of the owner or occupier of ancient lights.

Their lordships, on the application of Mr. Bray, suspended the operation of the injunction for a certain time to enable the defendant to lodge an appeal to the House of Lords.

A LEEDS FIRM'S COPYRIGHT CATALOGUE.

IN the Chancery Division on the 20th inst., before Mr. Justice Joyce, the Farnley Iron Co., Ltd., were granted an injunction restraining Messrs. Warrington & Son, of Berry Hill Works, Brook-street, Stoke-on-Trent, from printing and publishing any catalogues, &c., containing any plates or illustrations, or tabulated lists of bricks copied from or being a colourable imitation of those in the plaintiffs' book called "Farnley Price List—Glazed Brick Section."

Mr. Manby, for the defendants, said his clients had undoubtedly copied the catalogue unwittingly, and they submitted to the injunction.

RECENT PATENTS:

ABSTRACTS OF PATENTED INVENTIONS.

15,187.—A LIFT-VALVE FOR BATH AND LAVATORY SERVICE: *M. M. Brophy.*—The projecting flange of the casing has a screwed cap and inclined edges, projections from the valve which slides in the cap fit with the inclined edges, and also engage with slots in the top disc, which is forced away from the valve with a coiled spring; the valve is opened or closed with the turning of the handle, which causes the projections from the valve to slide upon the inclines.

15,236.—AN APPLIANCE FOR TELEGRAPH AND OTHER POSTS: *L. K. Forsythe.*—Concrete bases for posts are fashioned with cross-sections and with ties, set lengthwise, of flat or angle section, upon their faces or angles at the bottom. The ties, which are bolted in position, may be joined underneath. The post is fastened in its footing with clamping-rings or with cross-tie bolts.

15,239.—A CLIP-AND-SLEEVE JOINT: *L. W. Bates.*—A flexible connexion has a protecting sleeve composed of coils in the form of wire fabric, whereof the axes lie in planes that are perpendicular to the axis of the sleeve, which is secured to the connexion with bolts and straps, a strip of leather being interposed. A similar fastening is used for attaching the pipe ends to the connexion.

15,267.—A CONTRIVANCE FOR USE WITH BALL-AND-FLOAT VALVES: *A. Hill.*—The inventor's object is to help the action of the float as it rises and closes the valve. He causes the valve-spindle to project above the casing, and loads it with weights, which will expedite the closing of the valve, and can be altered in their amount with a variation in the pressure.

15,322.—ADJUSTMENT OF SKY-LIGHTS: *A. Mönnig.*—Ventilation is obtained, and rain and snow are excluded, by means of a set of louvres or Venetian laths, within which the skylight is placed. The frame of the louvres rests, under normal conditions, upon the projecting frame, and is pivoted upon the axis of the skylight, which, together with the louvre-frame, can be turned clear of the window-frame. A stay-rod serves for adjusting the opening of the skylight within the louvre-frame.

15,328.—A FIRE-EXTINCTEUR: *A. C. Badger.*—Vertical wires, having projecting feet, carry the acid-bottle. They are encompassed with a ring, and are bent against the shoulders of the bottle. The stopper—which will fall out when the bottle is inverted—has a guide made of wires that hangs from a ring screwed on to the edge of a disc, which is screwed on to a plug beneath the capping, whereby one can adjust the height of the outer cage, in order that it may bear against the shoulder of the bottle. In another form the carrying wires are not bent inwards against the bottle.

15,344.—A SEPARATOR FOR CEMENT, &C.: *W. F. Goreham.*—For purposes of testing, the glass container, which has a small metallic cone at its base, is pressed against an india-rubber ring, whilst compressed air is forced into it from the serrated end of a tube down a branch of which the fine particles are carried, and so to the expansion chamber. The specification extends to apparatus upon a somewhat larger scale, in which the receiver is set at an inclination from the feed to the tail-end, and is fitted with helical feed and discharge arrangements.

15,349.—A GUARD FOR WOOD SAWING AND PLANING MACHINES: *E. L. Dutton.*—A curved steel blade or riving knife, which covers the back of a circular saw, and a front guard of aluminium or other metal, are pivoted to a pin upon an adjustable arm. A link, which is clamped to one end of a lever attached to the pin, will adjust the guard to the cut, and a screw in the other end of the lever will adjust the knife. In the case of a hand-feed planing machine, a guard mounted upon a pivoted arm that is pressed against the fence with a spring, covers the cutters, and the guard is forced aside by the work in passing over the cutters.

15,352.—BRICKS, BLOCKS, SLABS, &C., FOR BUILDERS' USE: *T. Rouse.*—These are fashioned with a central body, core, or part of lime-concrete faced with cement-concrete; the former material being composed of unslaked lime mixed with sand, gravel, pulverised stone, clinkers, slag, and so on, and steam in a closed mixer; and the latter material of Portland or other cement mixed with sand, broken granite, &c., and wetted with steam or water. The articles are pressed in moulds and subjected to steam or vapour at 212 deg. Fahr., to ensure a union between the two materials and to render the lime-concrete weatherproof.

15,388.—CONCRETE FLOORS: *M. Koenen.*—The ribs are laid upon wooden beams that are sustained in part with suspension or tie rods, and repose upon the lower flanges of the girders. The ceiling is secured to the beams which will sustain the temporary arching centres.

15,390.—A CONTRIVANCE FOR DOMESTIC FIRE-PLACES AND HEARTHS: *B. A. Lillie.*—For utilising waste heat a casting which has a covering of glazed tiles is inserted under the bars of the grate, underneath the bars at the back is fitted a triangular fire-brick, and sloped cross-strips of metal which are disposed immediately under the bars serve to turn the waste heat into the hollow hearth.

15,395.—HOT-WATER APPARATUS FOR SWIMMING-BATHS, VATS, &C.: *F. Stott.*—Pipes join a cylinder to the bath or tank, opposite to one of them is the water-supply pipe, and between the steam-pipe and the base of the cylinder is a pipe, fitted with a valve and fixed in such a manner that when the steam-valve and the water-pipe are closed the body of water will circulate and become re-heated by an auxiliary supply of steam.

15,416.—IMPROVEMENTS FOR CRANES: *H. A. L. Barry.*—As an improvement of the invention No. 20,606, of 1899, the hoisting-rope is secured to a link, which is hung from a lever having at its free end a pawl on the axle of a spring-drum, on which is wound a rope attached to the fall-block. Beneath that lever is pressed another pivoted lever, of which the other end carries a weighted pawl that will engage with a spur-wheel upon the axle of one of the carriage wheels. Side-links join the pulley of the fall-block to the hook—both being free to move in a slot in the fall-block to which is pivoted a lever which is also pivoted to an extension of one of the links. Whilst the carriage is at rest the spring in the drum is overpowered by the weight of the fall-block so that the plunger will be sustained as lifted, but in lowering, together with a retrograde movement of the carriage, the weighted pawl will lift the first-named lever through the second-named lever so as to free the first-named pawl for its engagement with a wheel and to stop the paying-out of the rope together with the fall of the fall-block. The inventor further contrives that the plunger shall be moved downwards in relation to the hook for engagement with a trigger-lever and dumping of the bucket, and that, in a variant form, the tripping-plunger shall be automatically worked with a cam upon the pulley-axle of the fall-block after the load has been raised, carried to the point of discharge, and lowered.

15,432.—MANUFACTURE OF PORTLAND CEMENT: *A. Gibb.*—The inventor substitutes peroxide of iron for the customary shale or clay, in order that the materials may be fused without the employment of less than 60 per cent. of lime. He also uses baryta as carbonate or silicate, &c., for the lime, in part, and for making the cement recommends sandstone, or sand, chalk, or limestone, with the residue derived from extracting copper from burned pyrites known as purple ore, and, it may be, clay, to be wetted and fashioned into small lumps; the melted product is granulated in water, drained, dried with the waste heat from the furnace, and then ground. For the furnace, which should have an oxidising flame, confer No. 11,301 of 1900.

15,446.—CONCRETE WALLS AND PARTITIONS: *G. L. Mouchel.*—Metal bars are embedded in the concrete, so as to afford resistance against thrusting and shearing. The outer walls of a silo are built up of slabs, which are inserted between grooved pillars of concrete or of iron, and have their upper and lower edges tongued and grooved, metal rods being used for strengthening purposes. During the progress of the work concrete beams are moulded between the pillars over the slabs, from time to time, and grout is run into the joints. Other adaptations are specified.

15,453.—FIREPROOF FLOORING: *L. Pitsch.*—For constructing fireproof floors are devised slabs or blocks, having recesses in them, which are to be laid upon girders and ribbed joists, and to be embedded in concrete or cement.

15,501.—BURNERS FOR BLOW-PIPES: *T. Fletcher, A. Neil, and Fletcher, Russell, & Co.*—The Bunsen burners are intended for use in small "blast furnaces," more particularly those that serve for experimental purposes and are equipped with crucibles; for a protection of the gauze from the heat of the furnace after the blast has been turned off the gauze-plate is fitted with a guard-cap or cover.

15,521.—A CONTRIVANCE FOR THEODOLITES: *H. D. Hoskold.*—To enable one to take observations down a shaft by turning the telescope into a vertical position, the vertical axis of the theodolite is made hollow, and in order that the telescope shall clear the plate (the length of the standards not having

COMPETITIONS, CONTRACTS, AND PUBLIC APPOINTMENTS.

(For some Contracts, &c., still open, but not included in this List, see previous issues.)

COMPETITIONS.

Nature of Work.	By whom Required.	Premiums.	Designs to be delivered
*New Club House	Royal Norfolk & Suffolk Yacht C.	25*l.*, 20*l.*, 15*l.*	No date

CONTRACTS.

Nature of Work or Materials.	By whom Advertised.	Forms of Tender, &c., Supplied by	Tenders to be delivered
Granite Road Metal	Newmarket U.D.C.	S. J. Ennion, Deva Chambers, Newmarket	Dec. 31
Sewers, Little Thurrock	Orsett R.D.C.	R. T. Stewart, Surveyor, Council Offices, Orsett	Jan. 1
*Making-up Catisfield-road	Enfield U.D.C.	Council's Surveyor, Court House, Enfield	do.
Sewerage Works	Marlborough (Wilts) Town Council	Fairbank & Son, Civil Engineers, 13, Lendal, York	Jan. 3
Wrought-iron Railings, &c.	Branksome (Dorset) U.D.C.	W. H. Curtis, Council Offices, Branksome	do.
Flint and Granite Road Metal, &c.	West Sussex County Council	W. B. Purser, Civil Engineer, 4, Worthing-road, Horsham	Jan. 4
Street Works	Wolverhampton Corporation	G. Green, Borough Engineer, Town Hall, Wolverhampton	do.
26 Blocks of Buildings at Hospital, Seacroft	Leeds Corporation	E. T. Hall, Architect, 54, Bedford-square, W.C.	do.
Masonry Work, Walls, &c.	Cardiff Corporation	W. Harpur, Civil Engineer, Town Hall, Cardiff	do.
Office Buildings, Edinburgh	Mid-Lothian County Council	J. M. Henry, Architect, 7, South Charlotte-street, Edinburgh	Jan. 6
Excavating Works, Foundations, &c.	Tynemouth Corporation	J. F. Smillie, Borough Surveyor, North Shields	Jan. 7
Schools, Kingsland	Holyhead School Board	R. E. Pritchard, Bradford House, Holyhead	do.
Hospital, Low Black Close, near Morpeth	Aslington U.D.C.	A. Wood, Surveyor, Market-place, Aslington	do.
*Steam Road Roller and Road Scarifier	Willesden District Council	Council's Engineer, Dyne-road, Kilburn, N.W.	do.
*Broken Granite and Flints	Kingston-on-Thames Corporation	Borough Surveyor, Clattern House, Kingston-on-Thames	Jan. 8
*New Cells and Cubicles, Alton Police Station	Southampton Corporation	County Surveyor, The Castle, Winchester	do.
Car Depot, Roath	Cardiff Corporation	W. Harpur, Civil Engineer, Town Hall, Cardiff	Jan. 9
Street Works, Glebe-street	Castleford U.D.C.	W. Green, Surveyor, Council Offices, Castleford	do.
*Rendering Baths Watertight & Reconstructing Drain	Hampstead Council	Borough Engineer, Town Hall, Hampstead	do.
School, Alltwen, Wales		W. W. Williams, Architect, 63, Wind-street, Swansea	Jan. 15
*Enlargement of Head Post Office, Plymouth	Commissioners of H.M. Works, &c.	Secretary's Office, Storey's Gate, S.W.	do.
*Widening London Bridge	Corporation of London	City Surveyor, Guildhall	Feb. 17
Cemetery Building Works, Stourbridge-road	Dudley Corporation	Borough Surveyor, Town Hall, Dudley	No date
Six Houses, Garden-street, Castleford, Yorks.	Mr. T. Illingworth	Garside & Pennington, Architects, Ropergate, Pontefract	do.
Bungalow, Aldwick, Bognor		Hall & Co., Architects, 10, Gray's Inn-square, W.C.	do.
Sewers, &c., Netherton	Dudley Corporation	Borough Surveyor, Town Hall, Dudley	do.
Chapel, Fellbeck, near Pateley Bridge		W. J. Morley & Sons, Architects, 269, Swan-arcade, Bradford	do.
Drainage Works at Police Station, Alnwick		J. Cresswell, County Surveyor, Moot Hall, Newcastle-on-Tyne	do.
Schools, St. John's-place, Northgate	Canterbury School Board	W. J. Jennings, Architect, Canterbury	do.
Footpaths, &c., Walton, Liverpool		F. H. Peate, Architect, 11, South Castle-street, Liverpool	do.

PUBLIC APPOINTMENTS.

Nature of Appointment.	By whom Advertised.	Salary.	Application to be in
*Clerk of the Works	Warwick Guardians	3*l.* per week	Jan. 1

Those marked with an asterisk (*) are advertised in this Number. **Competitions**, p. iv. **Contracts**, pp. iv. vi. viii. & x. **Public Appointments**, pp. xvii.

been increased) it is caused to slide in a sleeve that is fitted with stopping-pieces.

15,522.—Bar-fencing: *T. W. Palmer.*—For enabling one to adjust vertical bar-fencing upon inclined ground, the horizontal rail, which should have a channel-section, is fastened near the ground to uprights. The ends of the vertical bars are then passed through holes in the upper flange of the rail and so to the lower flange. The bars have shoulders which take the upper rail (having a U-section) that is passed over them. For each panel, or space between two standards, a bar is passed through a hole in the upper rail, and its lower and threaded end is also passed through the upper flange of the horizontal rail.

15,538.—A Bracket or Stage for Use with Ladders: *L. Troppmann.*—The hooks of the two slotted pierced bars are adapted for engagement with the ladder-rounds, and, being joined to one another with a screw and wing-nut, are clamped on to the side of the ladder, so that they will form a support for a platform or staging. The apparatus can be used to prevent a workman, or his tools, &c, from falling off a ladder that is laid upon a roof.

15,561.—A Trap for Gulleys: *W. Oates.*—On the side of the gulley is fashioned a small chamber, and an opening communicates from one to the other. At the top of the chamber is an outlet which a sliding plate, that is in engagement with sloped grooves, keeps separated from the inlet, and which is coned from both sides, so that the discharge pipe may be adjusted anglewise, and also may be grooved for cementing purposes.

15,568.—Ventilation of Walls: *H. F. Einfeldt.*—To keep the walls dry and prevent the spreading of dry rot or fungus, they are built with hollowed bricks that are laid so that their openings shall constitute continuous ventilation-shafts and air-flues. The bricks are made in different shapes; some have middle stiffening-ribs, and others are fashioned in an angular form for gable-ends.

15,632.—Tops for Chimneys and Ventilation Shafts: *O. H. Champagne & F. B. Tanguay.*—The central spindle supports a top that rotates around the up-take, and at the same time drives a fan which is attached to a sleeve within the up-take. The speed-gearing, provided with ball-bearings, comprises a pinion upon the sleeve of the fan, with intermediate pinions upon pins in a stationary basin, and a ring-wheel around the spindle.

MEETINGS.

Friday, January 3.

Architectural Association.—Mr. J. A. Gotch on "The Development of Domestic Architecture from the Twelfth to the Eighteenth Century," illustrated by lantern views. 7.30 p.m.

SOME RECENT SALES OF PROPERTY:

ESTATE EXCHANGE REPORT

December 13.—By Farebrother, Ellis, & Co. (at Kingston).

Kingston-on-Thames, Surrey.—Burton-rd., nine plots of freehold building land	£663

December 14.—By Norman & Son (at Hertford).

Puckeridge, Herts.—7 to 18, Ashton's-gardens, f.	1,435
Main-rd., 23 freehold building plots	318

December 16.—By Francis Dod & Co.

Clapton.—104, Northwold-rd., u.t. 79½ yrs., g.r. 5*l.* 10s., r. 36*l.*	390

By Heaps, Son, & Reeve.

Islington.—Union-sq., i.g.r. 68*l.* 5s., u.t. 25½ yrs., g.r. 24*l.* 7s. 6d.	530
55, Packington-st., u.t. 35 yrs., g.r. 6*l.* 6s., r. 55*l.*	415
Finsbury Park.—22, Upper Tollington Pk., u.t. 72 yrs., g.r. 6*l.* 15s., e.r. 45*l.*	515

By Batchelar & Son (at Woking).

Horsell, Surrey.—Woodham-rd., Wellington Lodge and 1 a. 0 r. 35 p., f.	2,475

By Hollis & Webb (at Leeds).

Roundhay, Yorks.—The Drive, &c., a block of freehold building land, area 10,600 yards	1,325

By December 17.—David Burnett & Co.

Hornsey.—44, Linzee-rd., u.t. 95½ yrs., g.r. 7*l.*, r. 40*l.*	425

By Farebrother, Ellis, & Co.

Hackney.—Ash Grove, f.g.r 47*l.* 14s., reversion in 24¾ yrs.	£2,020
Dalston.—Queen's-road, i.g.r. 32*l.* u.t. 27 yrs., g.r. 4*l.*	355

By Henry Hooper.

Clapham.—59, 61, and 63, Larkhall-lane, u.t. 35½ yrs., g.r. 8*l.* 10s.	975

December 18.—Foster & Cranfield.

Leslie, &c., Fifeshire.—The Inchdairnie Estate, 2,228 a. 2 r. 37 p., f. (including minerals)	66,000
Burntisland, Fifeshire.—The Grange Estate (including stone quarry), 461 a. 0 r. 11 p., f.	19,000
Saline, Fifeshire.—The Saline and Knock and Lethans Estate, 2,188 a. 0 r. 26 p., f. (including minerals)	38,000
Cardenden, Fifeshire.—The Balgreggie Estate, 602 a. 0 r. 37 p., f. (including minerals)	46,000

By Drivers (Holloway).

Holloway.—Hornsey-rd., &c., f.g. rents 30*l.*, reversion in 14¾ yrs.	800
George's-rd., f.g.r. 60*l.*, reversion in 58 yrs.	1,500

By Herring, Son, & Daw.

Streatham.—34 to 50, 60 to 70 (even), Besley-st.; also the Oxford Arms p.-h., f., r. 320*l.* 10s.	3,630

Inman & Crier.

Holloway.—Queen's-cres, the Marquis of Salisbury p.-h., &c., f.g.r. 120*l.*, reversion in 55 yrs.	3,400

By Rushworth & Stevens.

Pimlico.—31, Lower Belgrave-st., and piece of land adjoining, u.t. 7¼ yrs., g.r. 7*l.*, r. 100*l.*	390
35, Lower Belgrave-st., u.t. 7¼ yrs, g.r. 3*l.* 10s., r. 36*l.*	170
36, Commercial-rd., r. 36*l.*; also i.g.r. 5*l.*, u.t. 12 yrs., g.r. 10*l.*	155
43, Warwick-st., u.t. 22¾ yrs, g.r. 4*l.*, r. 65*l.*	920

By C. P. Whiteley.

Sidcup, Kent.—Half Way-st, Ye Old Black Horse p.-h.; also house adjoining, f, r. 100*l.*	3,000
Blackfriars.—40, Broadwall, c, r. 39*l.*	300

By German & German (at Ashby-de-la-Zouch).

Ashby-de-la-Zouch, &c., Leicester.—Portions of the Donington Estate, comprising enclosures of land, building sites, houses, cottages, &c., area about 160 a., f. (in numerous lots)	37,350

December 19.—By C. Rawlby Cross & Co.

Acton.—8, Gunnersbury-lane, u.t. 96 yrs., g.r. 7*l.* 15s., r. 45*l.*	52

11, Denehurst-gardens, u.t. 96 yrs., g.r. 7*l.* 10s., r. 42*l.*	£450
Shepherd's Bush.—60, Wendell-rd., u.t. 77 yrs., g.r. 6*l.*, e.r. 36*l.*	340
By H. DONALDSON & SON.	
Dalston.—58 and 60, Malvern-rd., u.t. 44 yrs., g.r. 10*l.*, r. 72*l.*	790
Commercial-road East.—No. 374, f., r. 55*l.*	955
By LANGRIDGE & FREEMAN.	
Bromley-by-Bow.—138 to 144 (even), St. Leonard-st., f.	660
By NEWBON, EDWARDS, & SHEPHARD.	
Shepherd's Bush.—21 and 23, Stowe-rd., u.t. 61½ yrs., g.r. 20*l.*, r. 80*l.*	645
Marylebone.—12, Nottingham-st., u.t. 8½ yrs., g.r. 38*l.*	300
Holloway.—216 and 218, Holloway-rd., f, r. 95*l.*	1,670
1 and 2, Slaney-pl., f., r. 38*l.* 4s.	500
7, Drayton Pk., u.t. 62 yrs., g.r. 8*l.*, r. 58*l.*	580
Kingsland.—9, Little Essex-st., u.t. 67 yrs., g.r. 4*l.* 15s., r. 40*l.*	410
Westbourne Park.—50, St. Luke's-rd., u.t. 55 yrs., g.r. 10*l.*, r. 68*l.*	430
Islington.—3. Hardinge-st., u.t. 29½ yrs., g.r. 6*l.*, r. 31*l.* 10s.	305
Finsbury.—10, Holywell-row, f., r. 30*l.*	720
By HENRY HENDRIKS (at Birmingham).	
Sparkbrook, Worcester.—113 to 119 (odd), Stoney-lane, u.t. 89 yrs., g.r. 15*l.*	650

Contractions used in these lists.—F.g.r. for freehold ground-rent; l.g.r. for leasehold ground-rent; i.g.r. for improved ground-rent; g.r. for ground-rent; r. for rent; f. for freehold; c. for copyhold; l. for leasehold; e. for estimated rental; u.t. for unexpired term; p.a. for per annum; yrs. for years; st. for street; rd. for road; sq. for square; pl. for place; ter. for terrace; cres. for crescent; yd. for yard.

PRICES CURRENT OF MATERIALS.

*** Our aim in this list is to give, as far as possible, the *average* prices of materials, not necessarily the lowest. Quality and quantity obviously affect prices—a fact which should be remembered by those who make use of this information.

BRICKS, &c.

	£ s. d.	
Hard Stocks	1 12 0	per 1,000 alongside, in river.
Rough Stocks and Grizzles	1 10 0	,, ,, ,,
Facing Stocks	2 12 0	,, ,, ,,
Shippers	2 8 0	,, ,, ,,
Flettons	1 8 0	,, at railway depôt.
Red Wire Cuts	1 12 0	,, ,, ,,
Best Fareham Red	3 11 0	,, ,, ,,
Best Red pressed Ruabon Facing.	5 5 0	,, ,, ,,
Best Blue Pressed Staffordshire	4 6 6	,, ,, ,,
Do., Bullnose	4 10 0	,, ,, ,,
Best Stourbridge Fire Bricks	4 4 0	,, ,, ,,
GLAZED BRICKS		
Best White and Ivory Glazed Stretchers	13 0 0	,, ,, ,,
Headers	12 0 0	,, ,, ,,
Quoins, Bullnose, and Flats	17 0 0	,, ,, ,,
Double Stretchers	19 0 0	,, ,, ,,
Double Headers	16 0 0	,, ,, ,,
One Side and two Ends	19 0 0	,, ,, ,,
Two Sides and one End	20 0 0	,, ,, ,,
Splays, Chamfered, Squints	20 0 0	,, ,, ,,
Best Dipped Salt Glazed Stretchers and Headers	12 0	,, ,, ,,
Quoins, Bullnose, and Flats	14 0 0	,, ,, ,,
Double Stretchers	15 0 0	,, ,, ,,
Double Headers	14 0 0	,, ,, ,,
One Side and two Ends	15 0 0	,, ,, ,,
Two Sides and one End	15 0 0	,, ,, ,,
Splays, Chamfered, Squints	14 0 0	,, ,, ,,
Seconds Quality White and Dipped Salt Glazed	2 0 0	,, less than best.

	s. d.	
Thames and Pit Sand	7 3	per yard, delivered.
Thames Ballast	6 0	,, ,,
Best Portland Cement	32 0	per ton, delivered.
Best Ground Blue Lias Lime	25 0	,, ,,

NOTE.—The cement or lime is exclusive of the ordinary charge for sacks.

Grey Stone Lime ..... 11s 6d. per yard, delivered.
Stourbridge Fire-clay in sacks, 28s. od. per ton at rly. dpt.

STONE.

	s. d.	
Ancaster in blocks	1 11	per ft. cube, deld. rly. depôt.
Bath ,,	1 7	,, ,,
Farleigh Down Bath ,,	1 8	,, ,,
Beer in blocks	1 6½	,, ,,
Grinshill ,,	1 10	,, ,,
Brown Portland in blocks	2 2	,, ,,
Darley Dale in blocks	2 4	,, ,,
Red Corsehill ,,	2 5	,, ,,
Red Mansfield ,,	2 4	,, ,,
Hard York in blocks	2 10	,, ,,

	s. d.	
Hard York 6 in. sawn both sides landings, to sizes (under 40 ft. sup.)	2 8	per ft. super at rly. depôt
,, ,, 6 in. Rubbed Ditto	3 0	,, ,,
,, ,, 3 in. sawn both sides slabs (random sizes)	1 3	,, ,,
,, ,, 2 in. self-faced Ditto	0 9½	,, ,,
Hopton Wood (Hard Bed) in blocks	2	3 per ft. cube. deld. rly. depôt
,, ,, ,, 6-in sawn both sides landings	2	7 per ft. super. deld. rly. depôt.
,, ,, ,, 3-in. do.	1	2½ ,, ,,

PRICES CURRENT (*Continued*).

SLATES.

in. in.	£ s. d.	
20×10 best blue Bangor	11 5 0	per 1000 of 1200 at ry. dep.
,, best seconds ,,	10 15 0	,, ,,
16× 8 best ,,	6 2 6	,, ,,
20×10 best blue Portmadoc	10 18 0	,, ,,
16× 8 best blue Portmadoc	6 0 0	,, ,,
20×10 best Eureka unfading green	11 2 6	,, ,,
16× 8 ,, ,,	6 15 0	,, ,,
20×10 Permanent green	10 0 0	,, ,,
16× 8 ,, ,,	5 12 6	,, ,,

TILES.

	s. d.	
Best plain red roofing tiles	41 6	per 1,000 at rly. depôt
Hip and valley tiles	3 7	per doz. ,, ,,
Best Broseley tiles	48 6	per 1,000 ,, ,,
Hip and valley tiles	4 0	per doz. ,, ,,
Best Ruabon Red, brown or brindled Do. (Edwards)	57 6	per 1,000 ,, ,,
Do. ornamental Do.	60 0	,, ,, ,,
Hip tiles	4 0	per doz. ,, ,,
Valley tiles	3 9	,, ,, ,,
Best Red or Mottled Staffordshire Do. (Peakes)	50 9	per 1,000 ,, ,,
Hip tiles	4 1	per doz. ,, ,,
Valley tiles	3 8	,, ,, ,,

WOOD.

BUILDING WOOD.—YELLOW.

	At per standard. £ s. d.	£ s. d.
Deals: best 3 in. by 11 in. and 4 in. by 9 in. and 11 in.	13 10 0	15 10 0
Deals: best 3 by 9	13 0 0	14 10 0
Battens: best 2½ in. by 7 in. and 8 in. and 3 in. by 7 in. and 8 in.	10 0 0	11 0 0
Battens: best 2½ by 6 and 3 by 6	0 10 0	less than 7 in. and 8 in
Deals: seconds	1 0 0	less than best
Battens: seconds	0 10 0	,, ,, ,,
2 in. by 4 in. and 2 in. by 6 in.	8 10 0	9 10 0
2 in. by 4½ in. and 2 in. by 5 in.	8 0 0	9 0 0
Foreign Sawn Boards— 1 in. by 1½ in. by 1½ in.	0 10 0	more than battens.
¾ in.	1 0 0	,,
Fir timber: Best middling Danzig or Memel (average specification)	At per load of 50 ft. 4 10 0	5 0 0
Seconds	4 5 0	4 10 0
Small timber (8 in. to 10 in.)	3 12 6	3 15 0
Swedish balks	2 15 0	3 0 0
Pitch pine timber (30 ft.)	3 0 0	3 10 0

JOINERS' WOOD. At per standard.

White Sea: First yellow deals, 3 in. by 11 in.	22 0 0	23 0 0
3 in. by 9 in.	20 0 0	21 0 0
Battens, 2½ in. and 3 in. by 7 in.	15 0 0	15 0 0
Second yellow deals, 3 in. by 11 in.	17 0 0	18 0 0
,, ,, 3 in. by 9 in.	15 10 0	16 10 0
Battens, 2½ in. and 3 in. by 7 in.	12 0 0	13 0 0
Third yellow deals, 3 in. by 11 in. and 9 in.	12 10 0	13 10 0
Battens, 2½ in. and 3 in. by 7 in.	10 10 0	11 10 0
Petersburg: first yellow deals, 3 in. by 11 in.	19 0 0	20 0 0
Do. 3 in. by 9 in.	16 0 0	17 0 0
Battens	12 10 0	13 0 0
Second yellow deals, 3 in. by 11 in.	14 0 0	15 0 0
Do. 3 in. by 9 in.	13 0 0	14 0 0
Battens	11 0 0	12 0 0
Third yellow deals, 3 in. by 11 in.	11 10 0	12 10 0
Do. 3 in. by 9 in.	11 0 0	12 0 0
Battens	10 0 0	11 0 0
White Sea and Petersburg:— First white deals, 3 in. by 11 in.	13 10 0	14 10 0
,, ,, ,, 3 in. by 9 in.	12 10 0	13 0 0
Battens	10 10 0	11 10 0
Second white deals 3 in. by 11 in.	12 10 0	13 10 0
,, ,, ,, 3 in. by 9 in.	12 0 0	12 10 0
,, ,, battens	9 10 0	10 10 0
Pitch pine: deals	16 0 0	18 0 0
Under 2 in. thick extra	0 10 0	1 0 0
Yellow Pine—First, regular sizes	32 0 0	33 10 0
Broads (12 in. and up)	2 0 0	more.
Oddments	22 0 0	24 0 0
Seconds, regular sizes	24 10 0	26 10 0
Yellow Pine Oddments	20 0 0	22 0 0
Kauri Pine—Planks, per ft. cube	0 3 6	0 4 6
Danzig and Stettin Oak Logs— Large, per ft. cube	0 2 6	0 3 0
Small ,, ,,	0 2 3	0 2 6
Wainscot Oak Logs, per ft. cube	0 5 0	0 5 6
Dry Wainscot Oak, per ft. sup. as inch	0 0 8	0 0 7
¾ in. do. do.	0 0 7	- - -
Dry Mahogany— Honduras, Tabasco, per ft. sup. as inch	0 0 9	0 0 11
Selected, Figury, per ft. sup. as inch	0 1 6	0 2 0
Dry Walnut, American, per ft. sup. as inch	0 0 10	0 1 0
Teak, per load	16 0 0	20 0 0
American Whitewood Planks— Per ft. cube	0 3 0	0 3 6

Prepared Flooring— Per square

1 in. by 7 in. yellow, planed and shot	0 13 0	0 16 6
1 in. by 7 in. yellow, planed and matched	0 13 6	0 17 6
1½ in. by 7 in. yellow, planed and matched	0 15 0	1 0 0
6 in. at 6d. per square less than 7 in.		
1 in. by 7 in. white, planed and shot	0 11 0	0 12 6
1 in. by 7 in. white, planed and matched	0 11 6	0 13 6
1½ in. by 7 in. white, planed and matched	0 13 6	0 15 6
6 in. at 6d. per square less than 7 in.		

PRICES CURRENT (*Continued*).

JOISTS, GIRDERS, &c.

	In London, or delivered to Railway Vans, per ton. £ s. d.	£ s. d.
Rolled Steel Joists, ordinary sections	6 5 0	7 5 0
Compound Girders ,, ,,	8 0 0	9 0 0
Angles, Tees and Channels, ordinary sections	8 2 6	9 2 6
Flitch Plates	8 10 0	9 0 0
Cast Iron Columns and Stanchions, including ordinary patterns	7 0 0	8 0 0

METALS.

IRON.—	Per ton, in London. £ s. d.	£ s. d.
Common Bars	8 0 0	8 10 0
Staffordshire Crown Bars, good merchant quality	8 10 0	9 0 0
Staffordshire "Marked Bars"	10 10 0	- - -
Mild Steel Bars	9 0 0	9 10 0
Hoop Iron, basis price	9 5 0	9 15 0
,, ,, galvanised	16 0 0	- - -
(* And upwards, according to size and gauge.)		
Sheet Iron, Black.— Ordinary sizes to 20 g.	10 0 0	- - -
,, ,, to 24 g.	11 0 0	- - -
,, ,, to 26 g.	12 10 0	- - -
Sheet Iron, Galvanised, flat, ordinary quality.— Ordinary sizes, 6 ft. by 2 ft. to 3 ft. to 20 g.	12 10 0	- - -
,, ,, 22 g. and 24 g.	13 0 0	- - -
,, ,, 26 g.	14 0 0	- - -
Sheet Iron, galvanised, flat, best quality.— Ordinary sizes to 20 g.	16 10 0	- - -
,, ,, 22 g. and 24 g.	17 0 0	- - -
,, ,, 26 g.	18 10 0	- - -
Galvanised Corrugated Sheets.— Ordinary sizes, 6 ft. to 8 ft. 20 g.	12 10	- - -
,, ,, 22 g. and 24 g.	13 0 0	- - -
,, ,, 26 g.	14 0 0	- - -
Best Soft Steel Sheets, 6 ft. by 2 ft. to 3 ft. by 20 g. and thicker	12 5 0	- - -
,, ,, 22 g. and 24 g.	13 5 0	- - -
,, ,, 26 g.	14 5 0	- - -
Cut nails, 3 in. to 6 in. (Under 3 in. usual trade extras.)	9 10 0	10 0 0

LEAD, &c.

	Per ton, in London. £ s. d.	£ s. d.
LEAD—Sheet, English, 3 lbs. & up.	13 5 0	- - -
Pipe in coils	13 15 0	- - -
Soil Pipe	16 5 0	- - -
ZINC—Sheet— Vieille Montagne ton	24 10 0	- - -
Silesian	24 0 0	- - -
COPPER— Strong Sheet per lb.	0 1 0	- - -
Thin ,,	0 1 1½	- - -
Copper nails ,,	0 1 1½	- - -
BRASS— Strong Sheet ,,	0 0 11	- - -
Thin ,,	0 1 1	- - -
TIN—English Ingots ,,	0 1 3	- - -
SOLDER—Plumbers' ,,	0 0 0½	- - -
Tinmen's ,,	0 0 8	- - -
Blowpipe ,,	0 0 9	- - -

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15 oz. thirds	2¾d. per ft. delivered.
,, ,, fourths	2½d. ,, ,,
21 oz. thirds	3¾d. ,, ,,
,, ,, fourths	3½d. ,, ,,
26 oz. thirds	4¾d. ,, ,,
,, ,, fourths	4½d. ,, ,,
32 oz. thirds	5¾d. ,, ,,
,, ,, fourths	5½d. ,, ,,
Fluted sheet, 15 oz.	3½d. ,, ,,
,, ,, 21 ,,	4½d. ,, ,,
½ Hartley's Rolled Plate	2¾d. ,, ,,
⅜ ,, ,, ,,	3½d. ,, ,,
½ ,, ,, ,,	3¾d. ,, ,,

OILS, &c.

	£ s. d.	
Raw Linseed Oil in pipes	per gallon 0 2 10	
,, ,, ,, in barrels	,, 0 2 11	
,, ,, ,, in drums	,, 0 3 1	
Boiled ,, ,, in pipes	,, 0 3 0	
,, ,, ,, in barrels	,, 0 3 1	
,, ,, ,, in drums	,, 0 3 3	
Turpentine, in barrels	,, 0 2 3	
,, in drums	,, 0 2 6	
Genuine Ground English White Lead	per ton 21 10 0	
Red Lead, Dry	,, 21 10 0	
Best Linseed Oil Putty	per cwt. 0 8 6	
Stockholm Tar	per barrel 1 12 0	

VARNISHES, &c.

	per gallon. £ s. d.
Fine Elastic Copal Varnish for outside work	0 16 6
Best Elastic Copal Varnish for outside work	1 0 0
Best Elastic Carriage Varnish for outside work	0 16 0
Best Hard Oak Varnish for inside work	0 10 6
Best Extra Hard Church Oak Varnish for inside work	0 10 6
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Best Hard Copal Varnish for inside work	1 0 0
Best Hard Carriage Varnish for inside work	0 16 0
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Best Black Japan	0 16 0
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Berlin Black	0 16 0
Knotting	0 10 0
Best French and Brush Polish	0 10 0

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J. Woods	£17,544 6 7	G. H. Smith	£12,851 5 11
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Walker & Slater	13,450 0 0	Denholm & Co.	12,107 10 9
Dennis Gill & Son	12,923 6 0	Arnold & Son	11,975 0 0
		M. Grantham	11,970 9 4

[Architect's estimate, £12,250.]

FRING (Norfolk).—For alterations and repairs to the Hall, and erection of new lodge, schoolhouse, and other buildings at Fring, Norfolk. Messrs. William Jarvis & Son, architects, Paradise Parade, King's Lynn :—

W. H. Brown	£1,098 0	Jonas Chilvers, Snettisham*	£709 10
Bardell Bros.	1,049 0	Hipwell & Co.	795 0
Chambers & Sons	946 10		
J. W. Collins	814 0		

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Bardell Bros.	£657 0 0	Matsell & Walden	£502 16 10
W. H. Brown	650 10 0	Jonas Chilvers, Snettisham*	487 7 0
J. W. Collins	542 10 0	Hipwell & Co.	451 10 0
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W. H. Brown	£540 0 0	Matsell & Walden	£404 12 9
Bardell Bros.	519 0 0	J. W. Collins	402 0 0
J. Chilvers, Snettisham*	415 0 0	Chambers & Sons	382 12 0
		Hipwell & Co.	350 0 0

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Chambers & Sons	555 0 0	Hipwell & Co.	430 0 0
J. W. Collins	537 0 0		

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Lockerbie & Wilkinson, Ltd., Station-street, Birmingham, and 109, Victoria-street, London, S.W. £882 10

ILKLEY.—For the execution of street works, Eaton and St. James'-road, for the Urban District Council. Mr. T. H. Smith, Surveyor, Council Offices, Ilkley. Quantities by Surveyor :—

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Naylor & Sons	916 5 0	W. Barraud	811 14 5
Watmough & Preston	900 15 4	John Murdock	773 7 6
		Egan & Sons, Bradford*	760 14 2

WALSALL.—For constructional ironwork for the new municipal buildings. Mr. J. S. Gibson, architect, 4, Gray's Inn-square, W.C. :—

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WHITLEY (Northumberland).—For the formation of a new road, for the Urban District Council. Mr. J. P. Spencer, C.E., 30, Howard-street, North Shields :—

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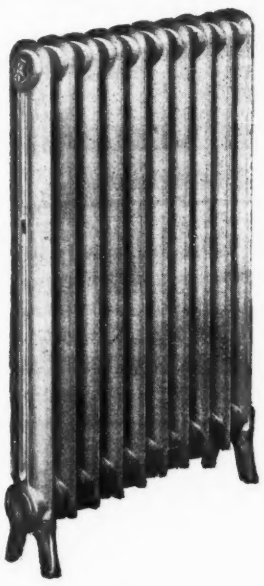

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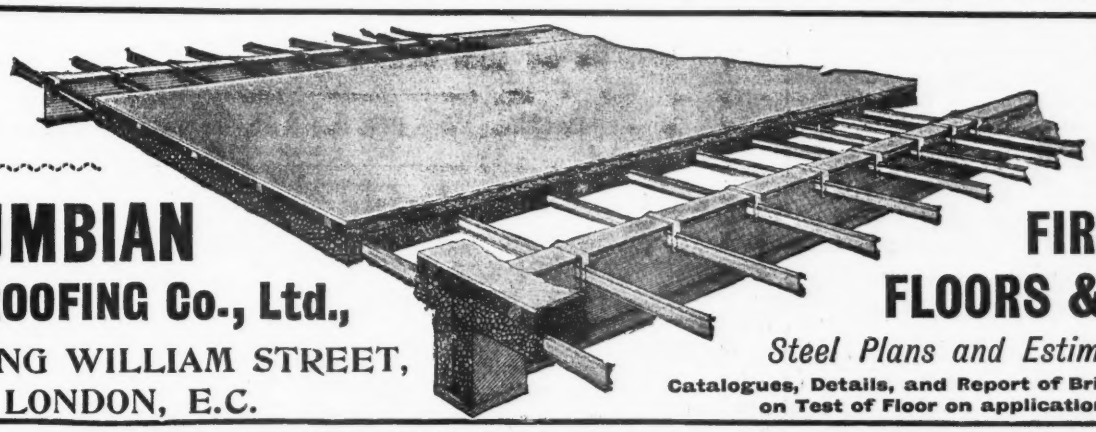

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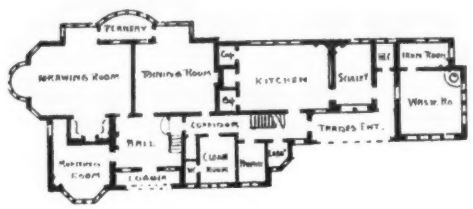

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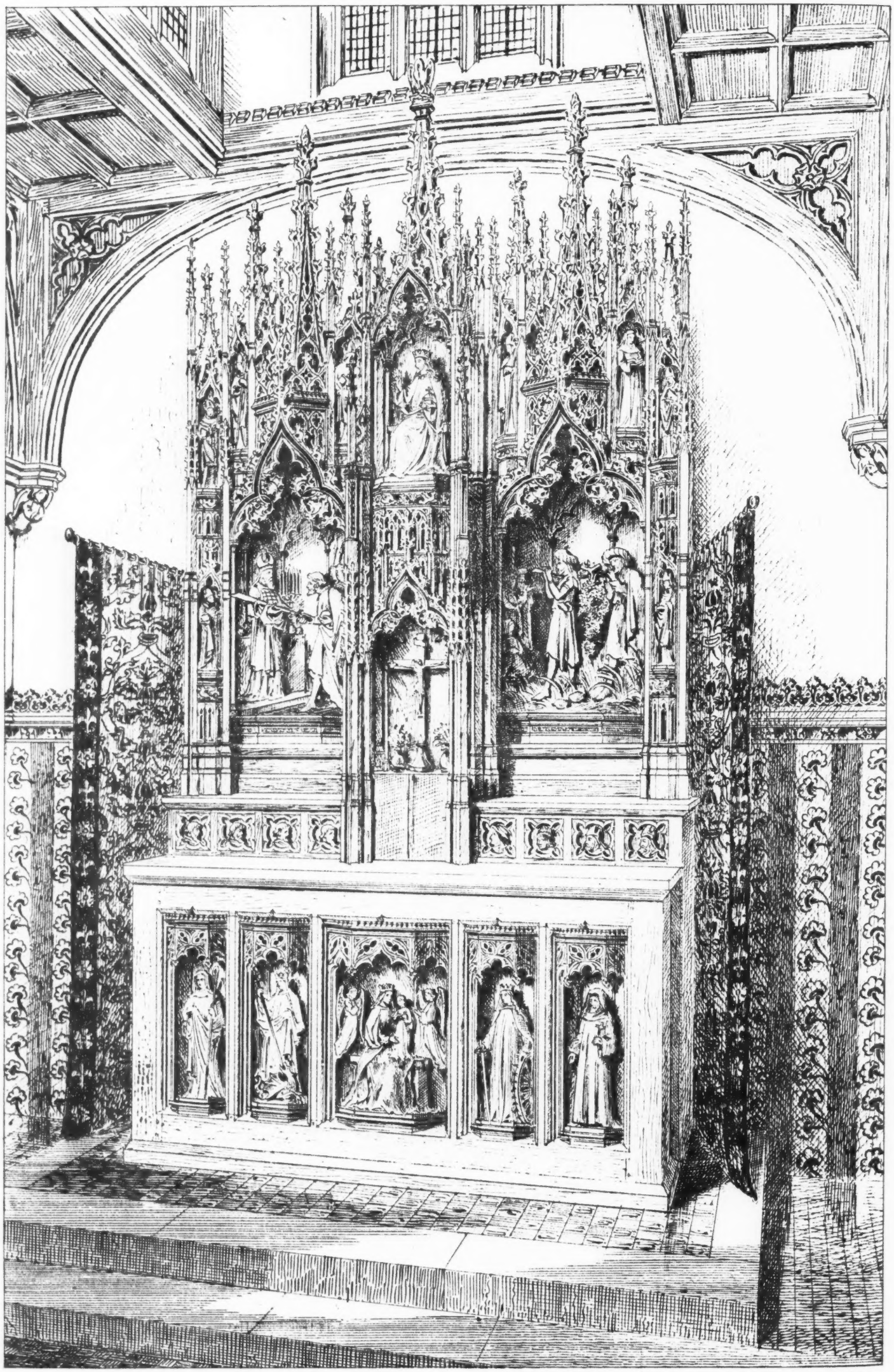

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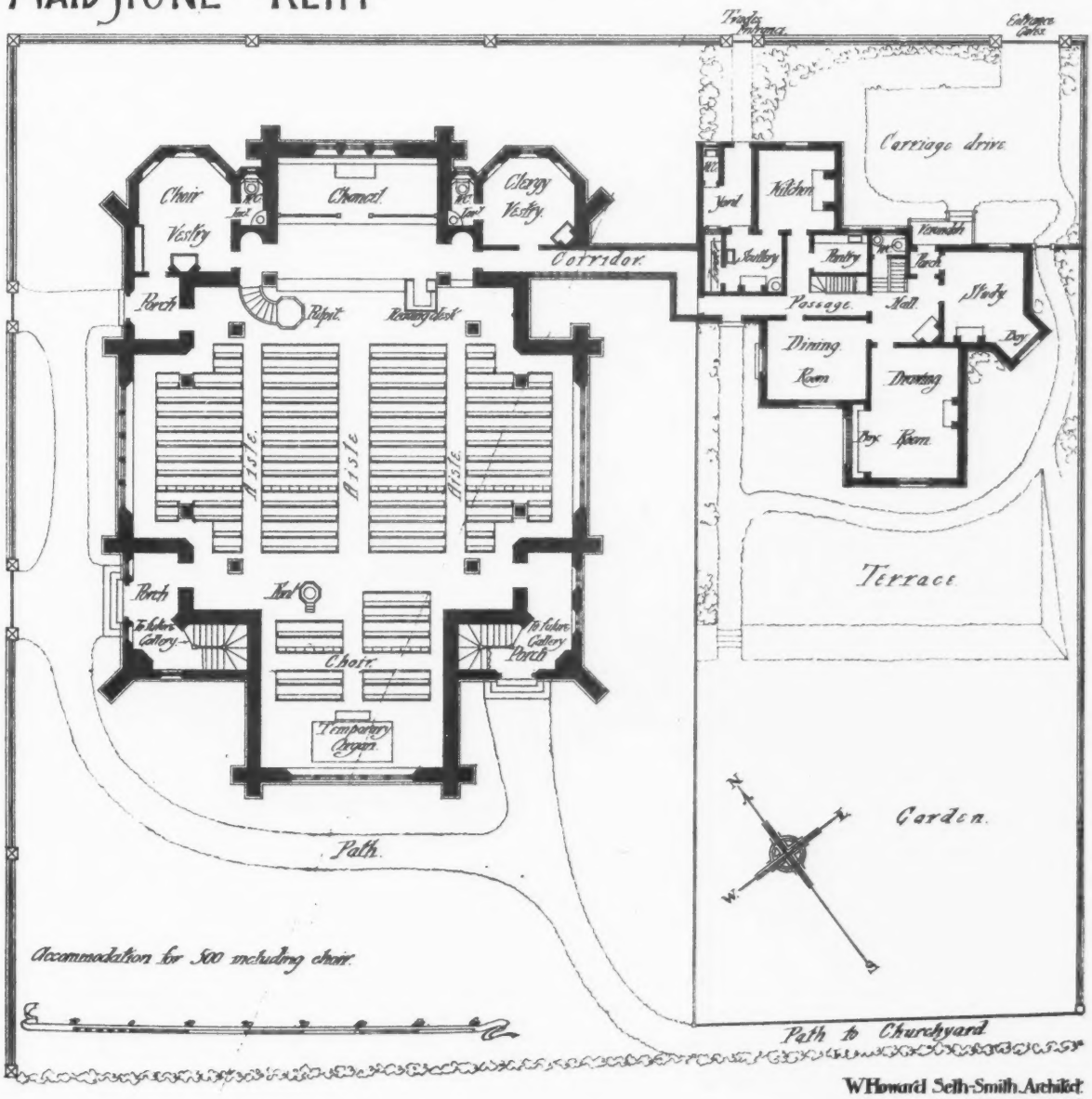

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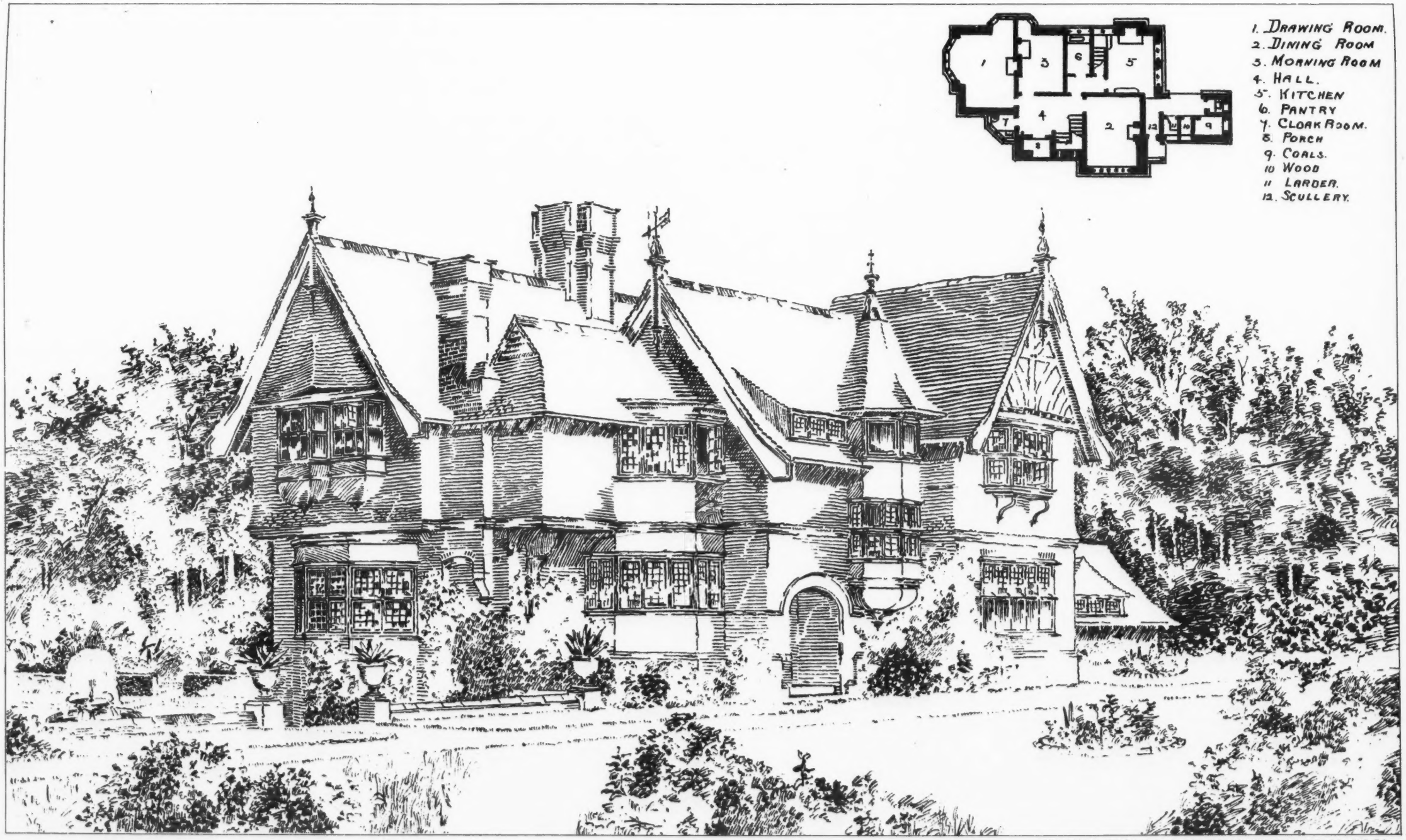

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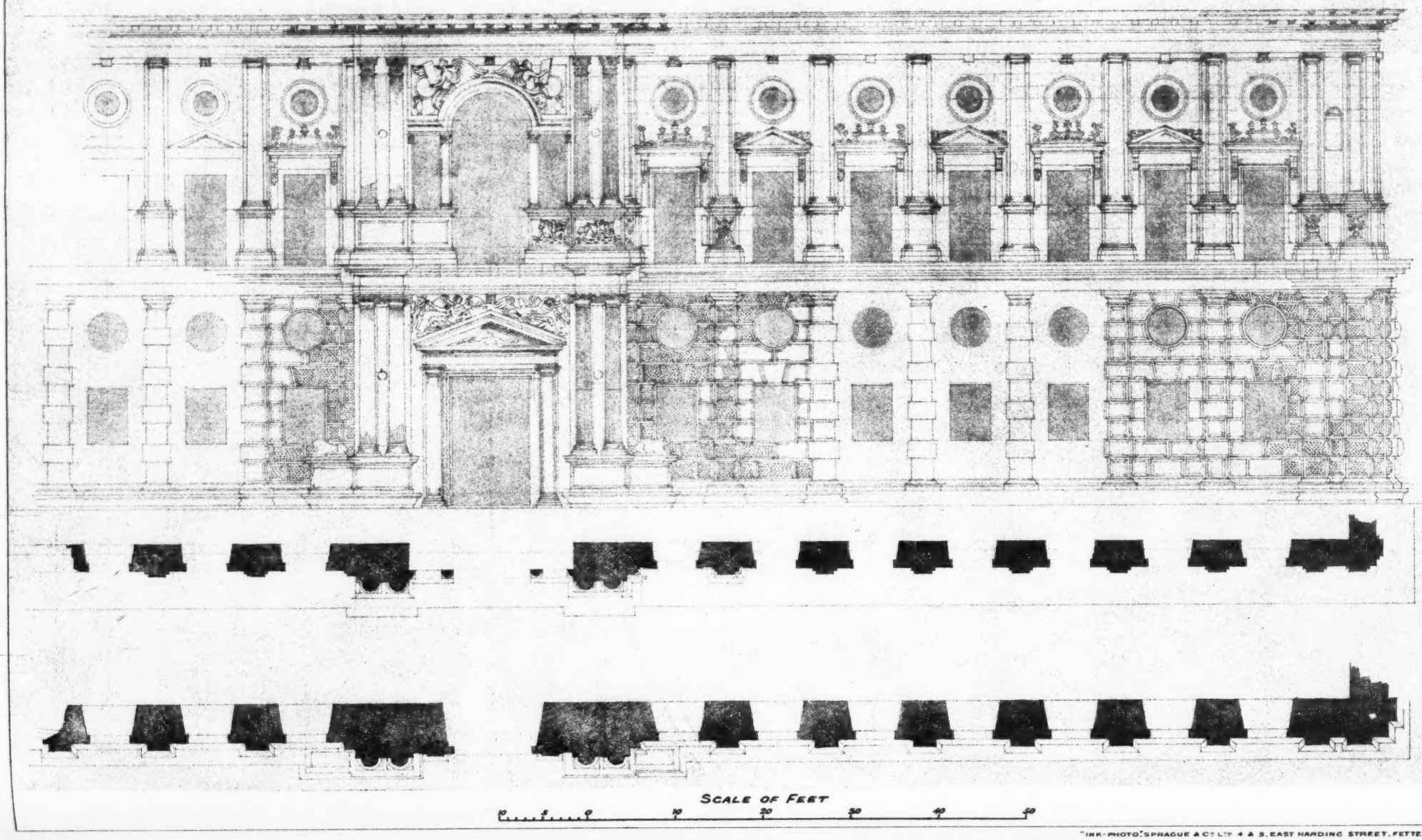

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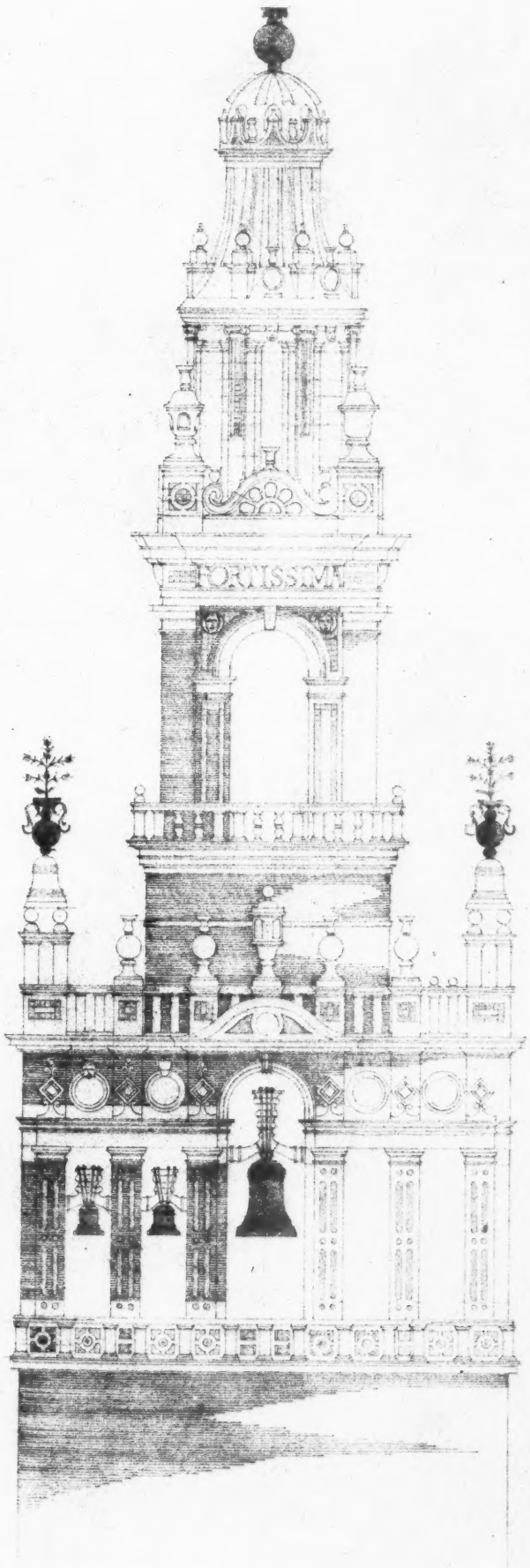

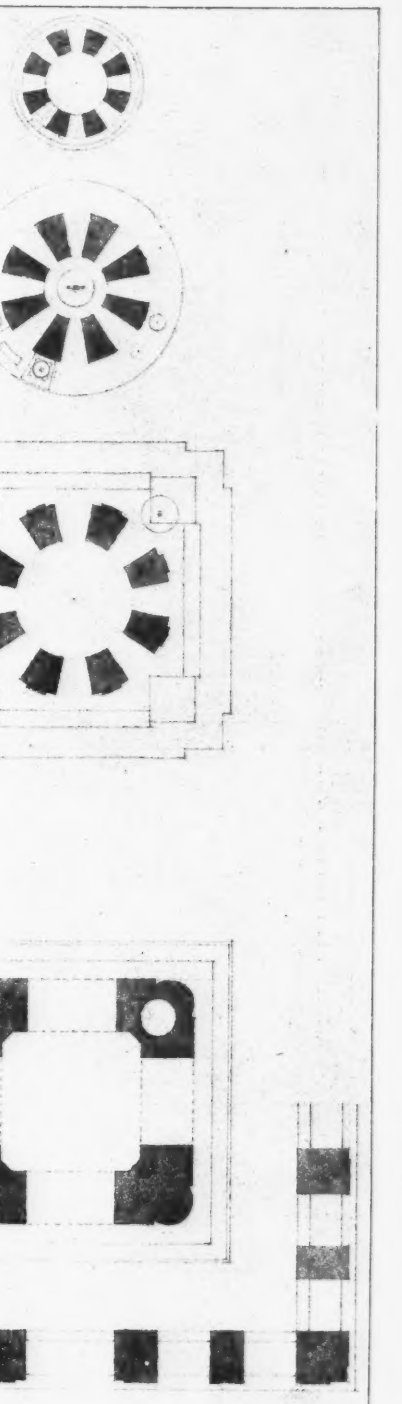

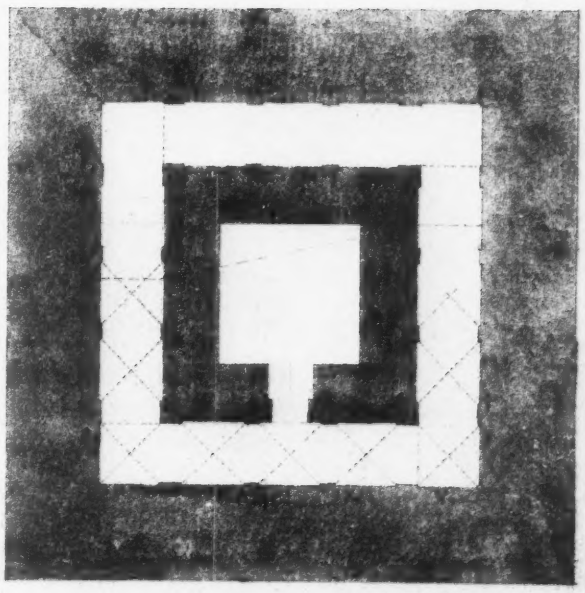

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Trenner, S. & Son

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McNeill, F. & Co.

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Doulton & Co. Ltd.
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Young & Marten, Ltd.

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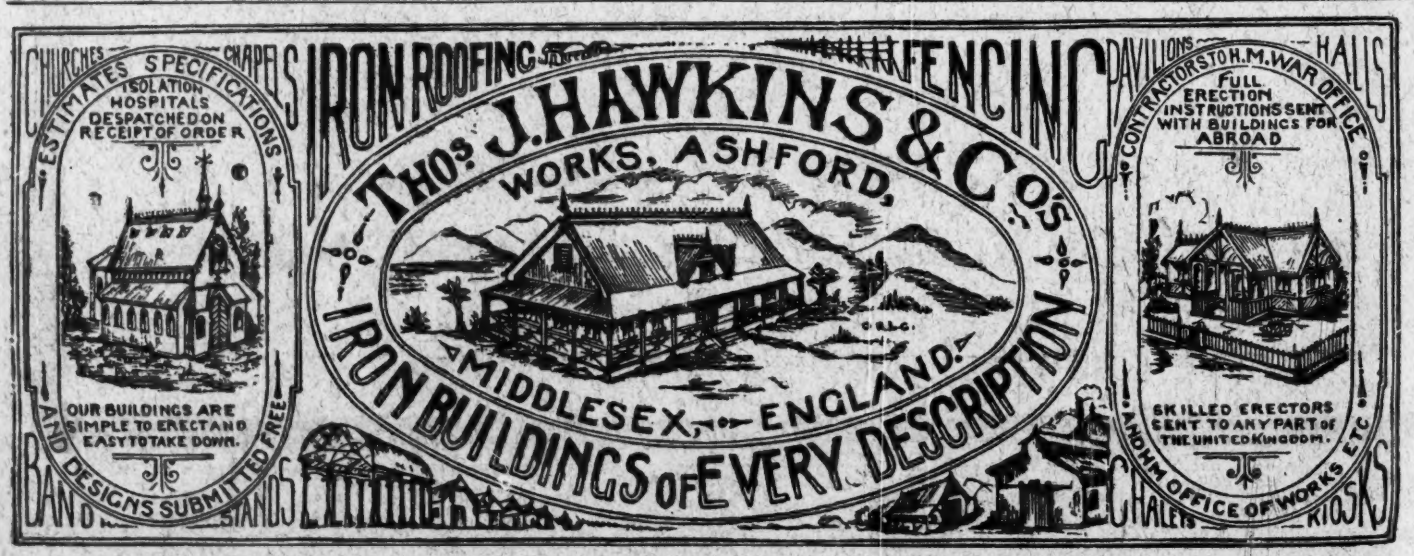
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COMPETITION.

COMPETITION.

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Mr. E. T. BOARDMAN, F.R.I.B.A. has consented to act as Honorary Advisor to the Committee.

Full conditions of the Competition can be obtained on application accompanied by a postal order of 10s. which will be returned after receipt of bonâ-fide drawings.

Applications for the conditions of Competition must be made on or before the 11th JANUARY, 1902.

H. TOWNLEY CLARKSON,
Secretary.

The Royal Norfolk and Suffolk Yacht Club House,
Lowestoft.

CONTRACTS.

TO BUILDERS.

The Commissioners of H.M. Works and Public Buildings are prepared to receive TENDERS for the ENLARGEMENT of the HEAD POST OFFICE at Plymouth.

Drawings, specification, and a copy of the conditions and form of contract may be seen on application to the Postmaster.

Bills of quantities have been prepared for the use of builders by Messrs. WIDNELL & TROLLOPE, of Broad Sanctuary Chambers, Tothill-street, S.W. and, together with forms of Tender, may be obtained at the undermentioned Office on payment of One Guinea. The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions specified below.

The Commissioners do not hold themselves responsible for the accuracy of the quantities, nor do they bind themselves to accept the lowest or any Tender.

Tenders are to be delivered before TWELVE o'clock noon on WEDNESDAY, the 15th proximo, addressed to the SECRETARY, H.M. Office of Works, &c. Storey's Gate, London, S.W. and endorsed "Tender for Plymouth Head Post Office Enlargement."

H.M. Office of Works, &c.
December 16th, 1901.

COUNTY OF SOUTHAMPTON.

TO BUILDERS.

NEW CELLS AND CUBICLES AT ALTON.

Persons desirous of TENDERING for the ERECTION of NEW CELLS and CUBICLES at Alton Police Station may see plans and specification and obtain bills of quantities at the office of Mr. W. J. TAYLOR, County Surveyor, the Castle, Winchester, on and after MONDAY, the 23rd DECEMBER, 1901, between the hours of NINE a.m. and FIVE p.m. Saturdays NINE a.m. and ONE p.m.

A deposit of Two Guineas will be required for bill of quantities, which will be refunded on receipt of a bonâ-fide Tender.

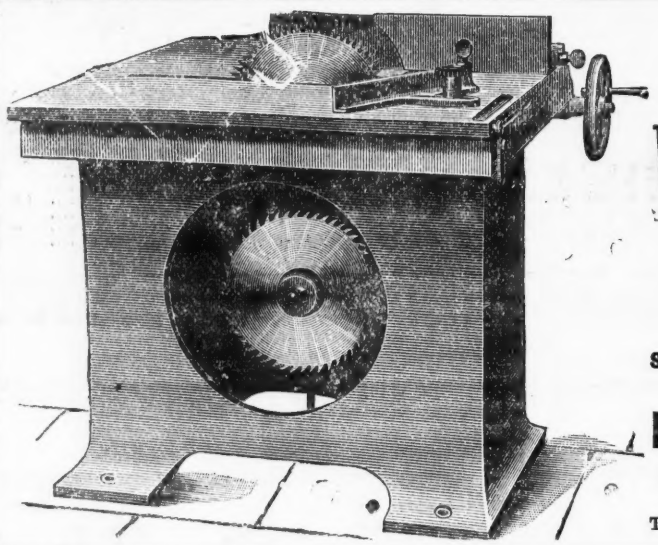
Tenders, endorsed "New Cells, Alton," to be on forms supplied by the County Surveyor, and to be delivered to me on or before WEDNESDAY, the 8th JANUARY, 1902.

The County Council do not bind themselves to accept the lowest or any Tender.

(Signed), H. BARBER,
Clerk of the County Council.

The Castle, Winchester,
December 17th, 1901.

[*See also page* vi.



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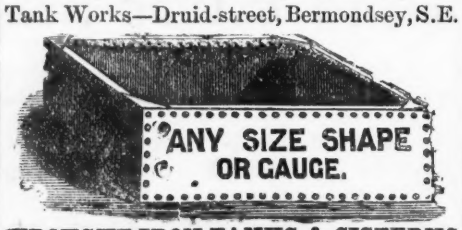

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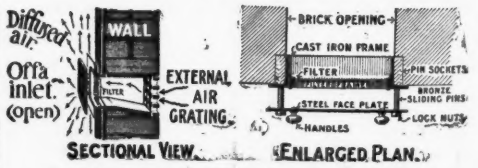

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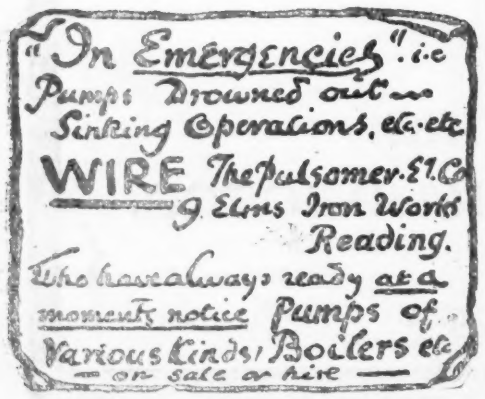
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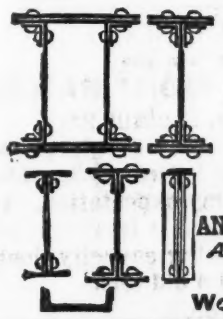

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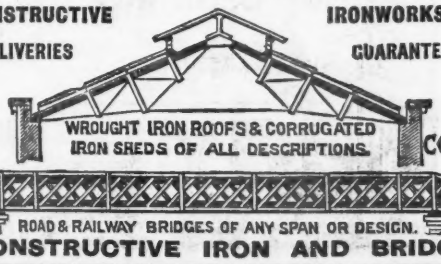

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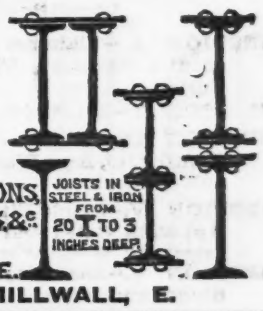

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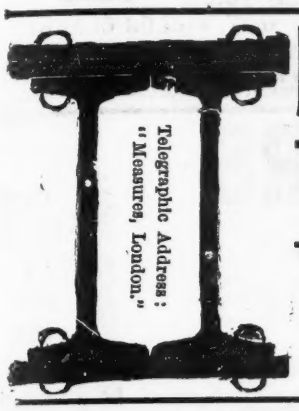

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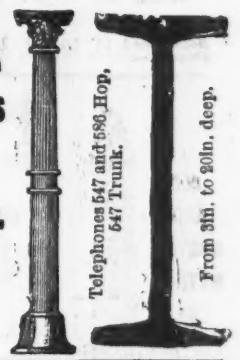

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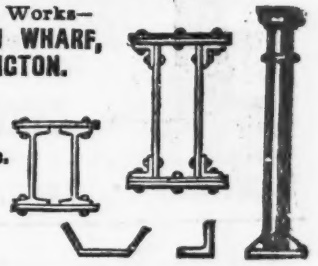

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Dear Sirs,—The **"Sine Qua Non" Range** exceeds my expectation. The consumption of coal is less than one-half and the cooking capacity double compared with the old one.

Faithfully yours,
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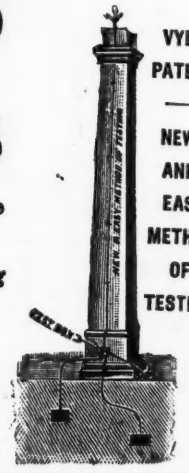

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CONTRACTS (*continued from p.* lv.)

CORPORATION of LONDON.

CONTRACT FOR WIDENING LONDON BRIDGE.

Notice is hereby given that the Bridge House Estates Committee of the Corporation of London will meet at the Guildhall on MONDAY, the 17th day of FEBRUARY, 1902, to receive TENDERS for the WIDENING of LONDON BRIDGE.

Drawings and specification may be seen at the office of the City Surveyor, Guildhall, on and after WEDNESDAY, the 1st day of JANUARY, 1902, between the hours of TEN a.m. and FOUR p.m.

Copies of the drawings, specification, form of Tender, contract and bond, and bills of quantities, may be obtained at the City Surveyor's Office, Guildhall on loan, on deposit of Ten Pounds, which will be returned to all who send in a bonâ-fide Tender and return all documents.

Tenders (which must be accompanied by the whole of the documents obtained on loan) must be on the printed form, which must not be detached from the specification, and must be sealed up and addressed to "The Bridge House Estates Committee, Guildhall," endorsed "Tender for the Widening of London Bridge," and left at the Hallkeeper's Office, Guildhall, London, E.C. before TWELVE o'clock noon on MONDAY, the 17th day of FEBRUARY, 1902.

The Committee do not bind themselves to accept the lowest or any Tender.

MONCKTON.

Guildhall,
December 12th, 1901.

BOROUGH of KINGSTON-UPON-THAMES.

GRANITE AND FLINTS.

The Corporation of Kingston-upon-Thames invite TENDERS for the SUPPLY of 1,350 tons of QUENAST, GUERNSEY, or other GRANITE suitable for road-making, 1,000 tons to be broken so as to pass through a ring having a 2-in. internal diameter, and the remainder through a 1½-in. ring, and 500 tons of FLINTS, suitable for road-making, and to be broken so as to pass through a 2½-in. ring. The above sizes will be strictly enforced.

The whole of the above to be delivered and unloaded into carts of the Corporation if required, and free of extra cost, at such wharf or towing path in the said borough as may be directed by the Borough Surveyor, or at the Kingston Station of the L. & S. W. Railway.

The persons whose Tenders are accepted will be required to enter into contracts to be prepared by me.

Separate Tenders, to be on forms to be obtained of the Borough Surveyor, Clattern House, where samples must be left.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders, endorsed as to the material tendered for, to be delivered at this Office on or before WEDNESDAY, the 8th JANUARY next.

HAROLD A. WINSER,
Town Clerk.

Town Clerk's Office,
Kingston-upon-Thames.
December 19th, 1901.

[*See also page* viii.

FOR THE INTRODUCTION OF FRESH AIR THROUGH AN EXTERNAL WALL.

PRICE LISTS ON APPLICATION.

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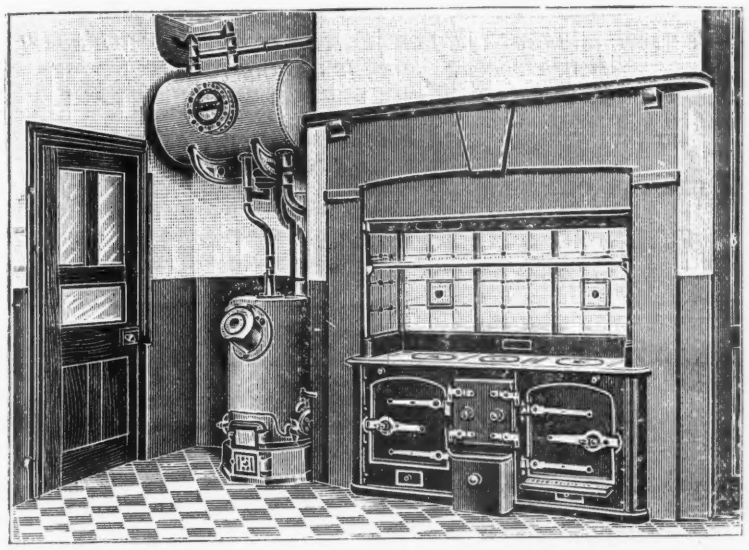

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For mixing with **COMMON LIME PLASTER.** XELEX mixed with Common Lime Plaster makes **PERFECT WORK,** with **GREAT RAPIDITY** and with **ECONOMY.** Two coats only are required, and the second may be applied within twenty-four hours. The total thickness need not be more than ⅝-in., thus saving much material. It is the best Plaster for Iron Lathing. It is adhesive and tough, and does not rust the ironwork.

For further particulars and Prices in London apply to

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Building Specialties.

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KINNEAR STEEL ROLLING SHUTTERS.
ART METAL WORK, GRILLES, etc.
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Horizontal Flame unaffected by Weather.
THE BEST IS THE SIMPLEST.

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THE BEST IS THE SIMPLEST.

	Price complete
No. 0.—500 Candles, small hand pattern for Petroleum only	£7 7 0
No 1.—1500 Candles, hand pattern, with No. 2 size burner for Tar Oil ...	£10 0 0
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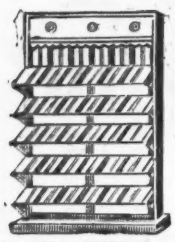
No. 4.—3500 Candles. A most powerful lamp	£17 15 0

A. C. WELLS & CO., 94, Midland-rd. St. Pancras. **LONDON.**



The "HELIOSCENE" Blind.

SPECIALLY SUITABLE FOR HOTELS, & is the only Outside Blind combining free view with perfect ventilation. Messrs. LOWTHER & CO. the original Patentees, now incorporated with the above.

THE KENSINGTON BLIND WORKS, LONDON, W.

MANUFACTURERS OF INSIDE AND OUTSIDE

WINDOW BLINDS

of every description, at the Lowest Possible Prices for Best Quality Work.

ESTIMATES AND DESIGNS FREE ON APPLICATION.

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Factory : BRIDGE ROAD and BLACK'S ROAD, HAMMERSMITH, W. LONDON, W.

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SPECIALITY Blinds for Offices and Banks.

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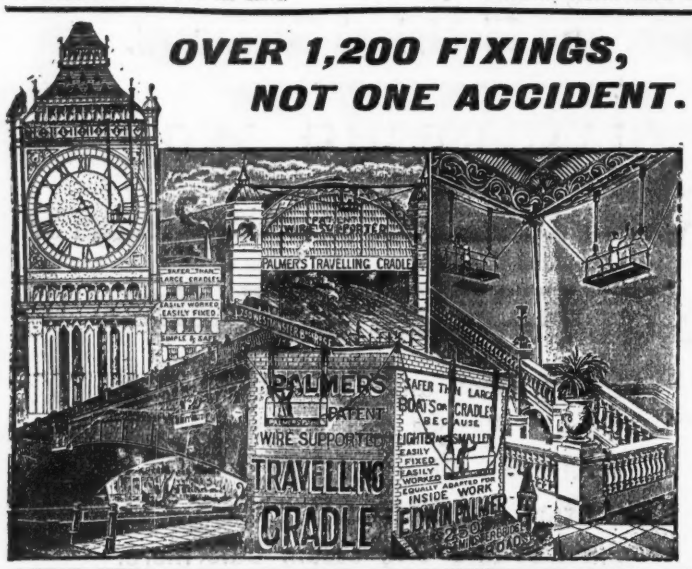

OVER 1,200 FIXINGS, NOT ONE ACCIDENT.

EMPLOYERS' LIABILITY

Reduced to its Lowest Point by using

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Is absolutely the Safest and Easiest means of reaching all work where staging is usually required.

FIXINGS SHOULD BE INCLUDED IN BUILDING PLANS.

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ENQUIRY INVITED FOR SPECIAL OR DIFFICULT STAGING.

PALMER'S TRAVELLING CRADLE, Ltd.,
250, Westminster Bridge Road, S.E.
Telephone No. 1,156 "Hop." Telegrams, "Wireway, London."

CONTRACTS (*continued from p.* vi.).

URBAN DISTRICT COUNCIL of ENFIELD.

TO CONTRACTORS.

The Council invite TENDERS for MAKING UP CATISFIELD ROAD, Enfield Lock.

Plans and specification can be seen, forms of Tender and all information obtained, on application to Mr. RICHARD COLLINS, the Council's Surveyor, at these offices any day except Saturday between the hours of NINE a.m. and FIVE p.m.

Tenders (on forms to be obtained at this office only) to be sent in to me not later than NOON on WEDNESDAY, the 1st day of JANUARY next, endorsed "Tender for Making-up Catisfield-road."

The Council do not bind themselves to accept the lowest or any Tender.

By order,
T. W. SCOTT,
Clerk to the Council

Court House, Enfield,
December 19th, 1901.

BOROUGH of HAMPSTEAD.

TO BUILDERS AND CONTRACTORS.

The Council of this Borough invite TENDERS for the following WORKS at Hampstead Public Baths, 175, Finchley-road, N.W.

1. For rendering water tight the Men's 1st Class and the Ladies' 1st class Swimming Baths.
2. For reconstructing main drain in 12-inch cast iron pipes.

Specification can be seen, and separate forms of Tender obtained, on application to C. E. WINTER, A.M.I.C.E. Borough Engineer, at the Town Hall, Hampstead.

The persons or firms whose Tenders are accepted will be required to enter into written contracts, and as regards item No. 1, above, to provide two sureties for the due performance of the same. The expenses of contracts and bond to be paid by the contractors.

Sealed Tenders, endorsed (1) "Rendering Baths water-tight," or (2) "Reconstructing drain at Baths," to be delivered at my office by FOUR p.m. on THURSDAY, 9th JANUARY 1902.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
ARTHUR P. JOHNSON,
Town Clerk.

Town Hall, Haverstock Hill, N.W.
December 21st, 1901.

See also page x.

COPPER ROOFING

As Economical as Lead.

For Flats Towers Domes Flêches Mansards

EWART & SON LIMITED
LONDON N.W.

WOOD WORKING MACHINERY

Of all kinds, and with
EVERY RECENT IMPROVEMENT.

Can be seen and tested in Trial Shops.

A LARGE STOCK FINISHED & READY FOR IMMEDIATE DELIVERY.

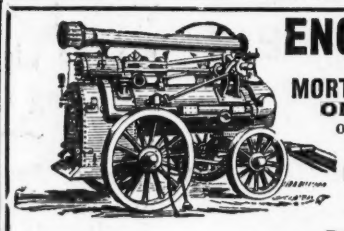
Call or Write for Catalogue.

SYDNEY BUTLER, Park Works, GLASSHOUSE-STREET, Vauxhall, S.E.
(Three minutes from Vauxhall Station, South-Western Railway.)

HIRE ! HIRE ! HIRE !

HIGH-CLASS ENGINES, MORTAR MILLS, HOISTS, CRANES, BRICK CRUSHERS, TRACTION ENGINE, &c.
At Moderate Prices.
REPAIRS AND CASTINGS.

LEWIS & LEWIS, Engineers and Ironfounders, Townmead-road, Fulham, London, S.W.
Telegrams, "Lewises, London."
Telephone No. 552, Kensington.



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Catalogues free on application.

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PUMPS, LOCO, STEAM CRANES.
PORTABLE, HORIZONTAL, and VERTICAL ENGINES and BOILERS, 2 to 30 h.p.
EVERY DESCRIPTION OF BUILDERS', CONTRACTORS', and SAW MILL MACHINERY, New and Second-hand.
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STONE-BREAKERS, hand, horse, or steam power, also MORTAR MILLS and CONCRETE MIXERS. A few second-hand ones that have been out, for SALE, cheap. Also a BRICK BREAKING MACHINE, DISINTEGRATOR, and ENGINE let out on HIRE, with option of Purchase.—MASON BROS. (late S. Mason & Co.), Stone Breaking and Grinding Machine Manufacturers, Leicester.

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DURHAM BROS., Atlas Foundry,
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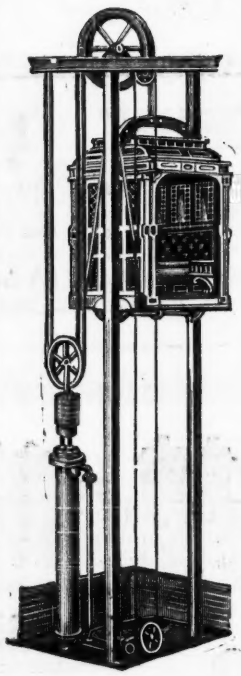
[*See also page x.*

PICKERINGS'

LIFTS.



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Extinguish your Artificial Lights and bring in Daylight

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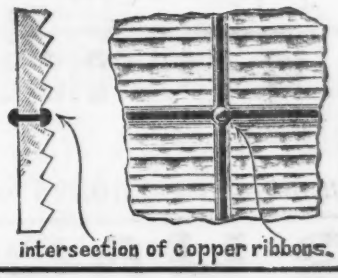

intersection of copper ribbons.

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Telephone: 90, London Wall. **16, HILL STREET, FINSBURY, E.C.** Telegrams: Luxfer, London.

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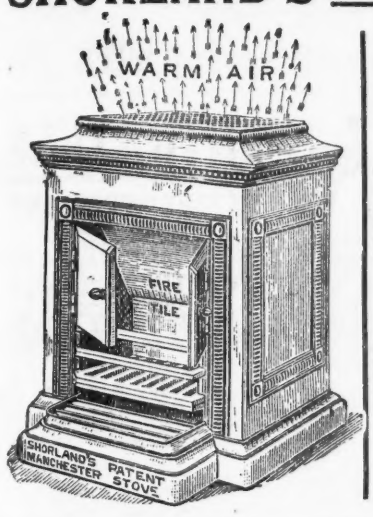

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ROOF VENTILATORS.

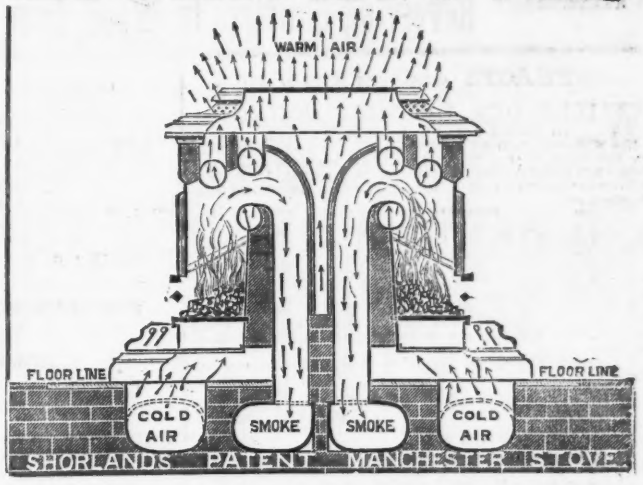
E. H. SHORLAND & BROTHER

Drake-street Works, Stretford-rd.,

MANCHESTER.

Telegrams—WARMING, Manchester.

Nat. Telephone—No. 2188.



Telephone: No. 890 Bank.

CARRON COMPANY,

Telegraphic Address "Carronade, London."

15, UPPER THAMES STREET, LONDON, E.C.

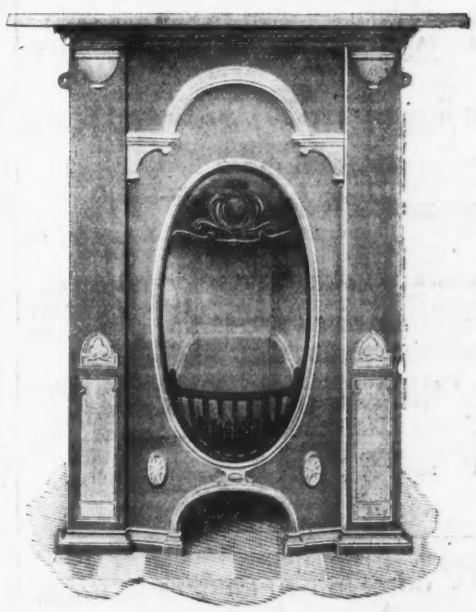
30, Redcross Street, LIVERPOOL; 125, Buchanan Street, GLASGOW; 24, Brazennose Street, MANCHESTER; 10, Victoria Street, BRISTOL; 22, Blackett Street, NEWCASTLE-ON-TYNE; Guildhall Buildings, BIRMINGHAM.

WORKS: CARRON, STIRLINGSHIRE, N.B.

NEW DESIGNS OF MANTEL REGISTERS.

No. 510. MANTEL REGISTER.
30 in. wide × 48 in. high. 12 in. Fire.

No. 466. MANTEL REGISTER.
34 in. wide × 51 in. high. 12 in. Fire.
42 in. wide × 60 in. high. 14 in. Fire.



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Manufacturers of all

HIGH-CLASS JOINERY, Shop and Office Fittings,
Furniture to the Trade, and Wood Mantelpieces.

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S. W. FRANCIS & CO., LIMITED. 64 to 70 (late 174), Gray's Inn-road, London.

MANUFACTURERS OF EVERY KIND OF
IMPROVED REVOLVING SHUTTERS, in WOOD, IRON, and STEEL.
SUITABLE FOR BANKS, MANSIONS, SHOPS, AND PUBLIC BUILDINGS.
BRASS SHOP-FRONTS and SPRING SUN-BLINDS at REDUCED PRICES.
ESTIMATES AND PRICE LIST FREE.

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Manufacturers of **Revolving Shutters in Wood, Iron, Steel, and Brass Shop Fronts, Spring Shop Blinds, &c.**

CONTRACTS (*continued from p* viii.).

WILLESDEN DISTRICT COUNCIL.
TO STEAM ROLLER MANUFACTURERS.

The Willesden District Council are prepared to receive TENDERS for the SUPPLY of a TEN TON STEAM ROAD ROLLER and ROAD SCARIFIER, complete in every respect and ready for use, to be delivered at the Store Yard of the Council within 14 days from order to supply same.

All particulars and form of tender may be obtained, on and after FRIDAY, the 20th day of DECEMBER, 1901, upon application to Mr. O. CLAUDE ROBSON, M.Inst.C.E. Engineer to the Council, Public Offices, Dyne-road, Kilburn, N.W.

Tenders, endorsed "Steam Roller and Road Scarifier," to be delivered at the Offices of the Council not later than FOUR p.m. on TUESDAY, JANUARY 7th, 1902.

A 10*l.* Note to be deposited with each Tender, which will be returned to unsuccessful contractors immediately Tenders are accepted, and to the successful contractor upon execution of contract and bond.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
STANLEY W. BALL,
Clerk to the Council.

Public Offices,
Dyne-road, Kilburn, N.W.
December 18th, 1901.

Refer also to "Too Late" column, page

FOR SALE, SECOND-HAND.

TWO-TON STEAM TRAVELLING CRANE, 20-ft. Jib, all motions by steam, nearly new (175*l.*).
STEAM DERRICK CRANES. One 5-ton (D.S.J.), one 30-cwt. (D.S.D.).
ELECTRIC WINCH, with Motor for 220 volts (2375).
TEN-CWT. BUILDER'S FRICTION HOIST.
ONE-TON STEAM WINCH, with Boiler on wheels (2074).
THREE-TON HAND DERRICK CRANE, by Butters, 65-ft. Jib (D.U.B.).
THREE-TON HAND DERRICK CRANE, by Gray, 60-ft. Jib (D.T.K.).
Six ½ yard contractor's Tipping Skips (D.S.B.)
Six ½ yard do. do. (2336).
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25-H.P. HORIZONTAL STEAM ENGINE (D.S.W.).
MORTAR MILL, with 9 ft. pan, Friction Rollers under pan and Timber Frame (2376.).
do. do. 8 ft. pan. (D.T.E.)
do. do. 7 ft. pan. (D.T.C.)
do. do. 6 ft. pan. (1173).
STONE BREAKER, 16 by 9, by Broadbent, with Screen on wheels (2377).
do. do. 12 by 6 (2195).
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PULSOMETER, No. 8, with Pipes, &c. (D.Q.B.).
CENTRIFUGAL PUMP, 6 in. (1379).
CIRCULAR and BAND SAWING MACHINE, for power (A.F.).
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DOOR CRAMPING MACHINE, by Robinson, £50 (U.D.)
CHAIN MORTISING MACHINE, by Robinson, £50 (U.S.).
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FOR SALE.
Nearly new CONCRETE MIXER complete by Wardell.
Also THREE TON STEAM LOCO CRANE
by The Bedford Engineering Co.
Address,
Box 159, Office of "The Builder."

RED RUBBERS.
GOOD RED RUBBERS FOR SALE.
Apply to,
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SPECIAL SCREENED SAND.
FINEST PATH GRAVEL, beautiful colour and good binding.
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RAILWAY SLEEPERS (large quantity of second-hand) FOR SALE, size 9 ft. by 9 in. by 4½ in.; also some half round, price 9*d.* each; 50,000 new SLEEPERS, size 6 ft. by 7 in. by 5½ in. ex wharf.—Apply
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100,000 SQUARES NEW YELLOW FEATHER-EDGE BOARDS, 1½ in. 6 ft. lengths, 5*s.* per square; Rough Boarding (yellow), 1 in. 6 ft. lengths, 6*s.* per square; 3 in. by 2 in. 4*s.* 6*d.* per 100 ft.; 3 in. by 3 in. 7*s.* 6*d.* per 100 ft.; 4 in. by 3 in. for posts, 10*s.* per 100 ft.; Arris Rails in any lengths, 5*s.* per 100 ft.; Palings, 5 ft. by 3 by ¾, 7*s.* per 100; Palings, 5 ft. by 2½ by ¾ 6*s.* 6*d.* per 100. All the above cut out of good yellow deals. Slating Battens, 2 by ¾, 10*s.* 6*d.* per 1,000 ft.—JOSEPH DRAPER, Grove Works, Este-road, Clapham Junction, S.W.

Refer also to "Too Late" column, page

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SCARIFIER.

Our Improved Scarifiers are used by His Majesty's Commissioners of Works, the London County Council, and a large number of Corporations and Local Bodies throughout the United Kingdom. For Terms, Hire or Purchase, apply to
GEO. G. RUTTY & CO. CONTRACTORS,
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Telegrams, "SCAPHA, LONDON."

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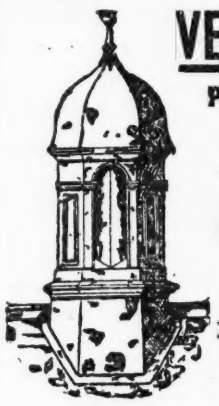
Well-known experts in arranging and fitting Turkish Baths made a valuable contribution to science in solving the problem of Heating economically and Ventilating efficiently the Turkish Bath Hot Rooms. The Free Trade Hall and Royal Exchange, Manchester, and many other large Halls and places of Worship have been well warmed for more than twenty years on their system.

Apply to J. CONSTANTINE & SON,
CONVOLUTED STOVE WORKS,
STOCKTON-ST. CLARENDON-ST.; OR 23, OXFORD-ST. MANCHESTER.



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GUARANTEED
ABSOLUTELY
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CONTRACTOR FOR WATERWORKS, GAS TANKS, ROADS, SEWERS,
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	1894.		1895.
1.	Westminster .. .. .. Jan.	8.	Fountains .. (out of print).
2.	Rievaulx .. .. July.	9.	Tynemouth .. .. .. Feb.
3.	Glastonbury .. .. .. Aug.	10.	Malmesbury .. .. March.
4.	Croyland .. .. Sept.	11.	Netley .. .. .. April.
5.	Whitby .. .. Oct.	12.	Bolton .. .. May.
6	Bath .. .. Nov.	13.	Lindisfarne .. .. .. June.
7	Tewkesbury .. .. .. Dec.	14.	Furness .. .. July.
	1896.	15.	Romsey .. .. Oct.
			1897.
16.	Kirkstall .. .. Jan.	20.	Great Malvern .. .. Jan.
17.	Abbey Dore .. .. April.	21.	Sherborne .. .. April.
18.	Selby .. .. July.	22.	Bayham .. .. July.
19.	Byland .. .. Oct.	23.	Pershore .. (out of print).
	1898.		1899.
24.	Melrose. .. ..(out of print).	29.	Llanthony .. (out of print).
25.	Waltham .. .. .. April.	29.	Hexham .. .. .. April.
26.	Tintern .. .. July.	30.	Valle Crucis .. .. .. July.
27.	Lanercost .. .. Oct.	31.	Cartmel .. .. Oct.
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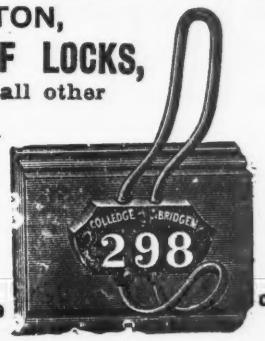

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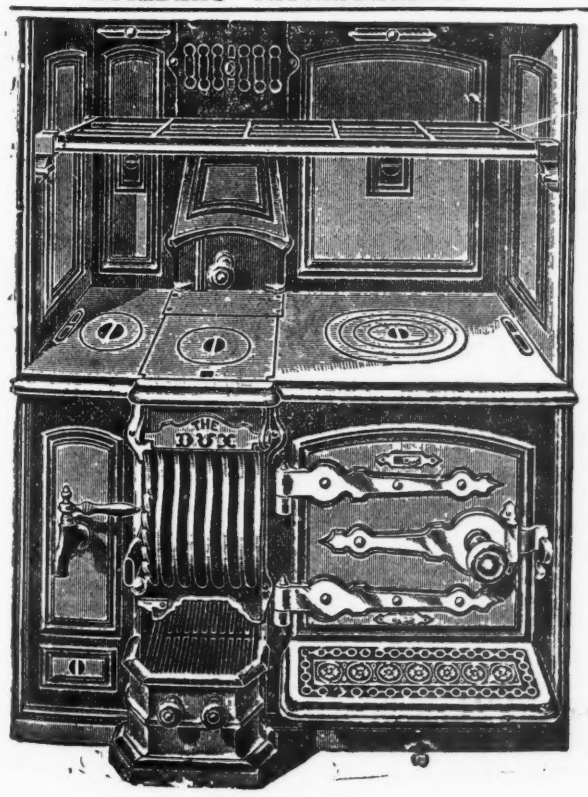

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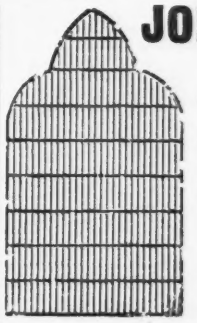

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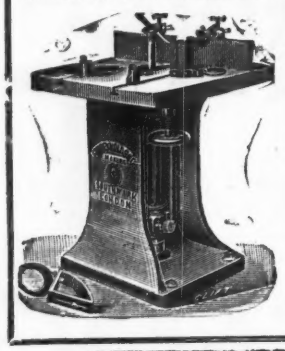

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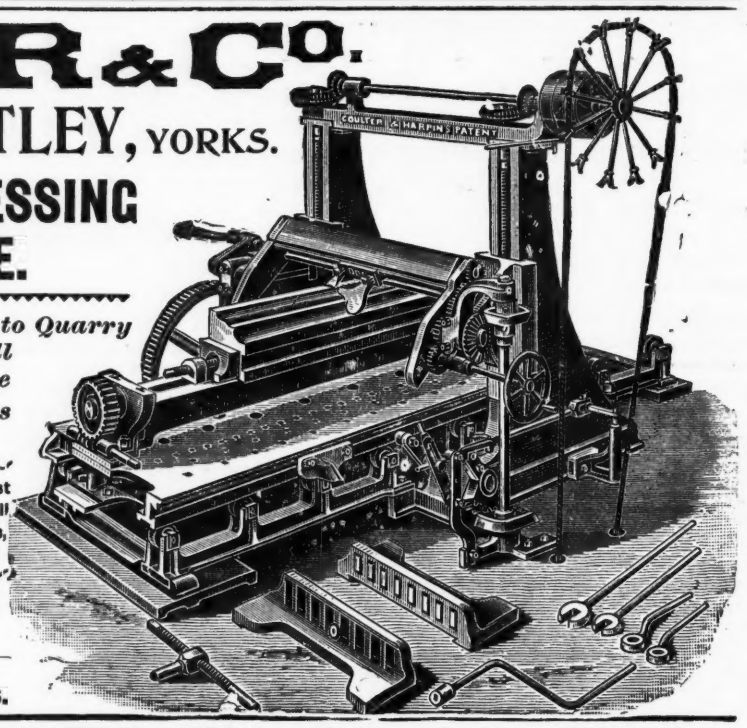

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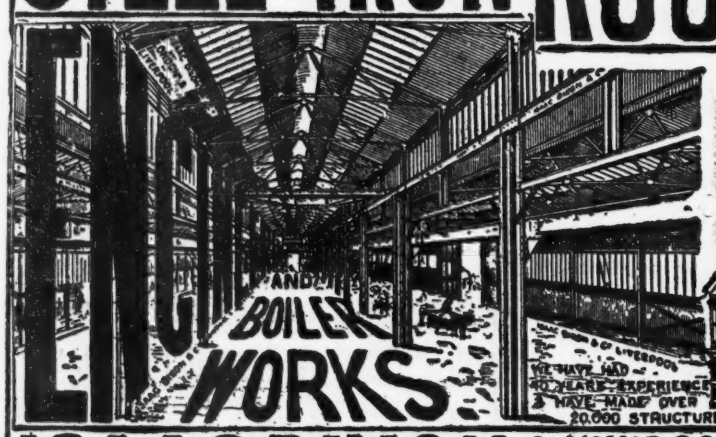

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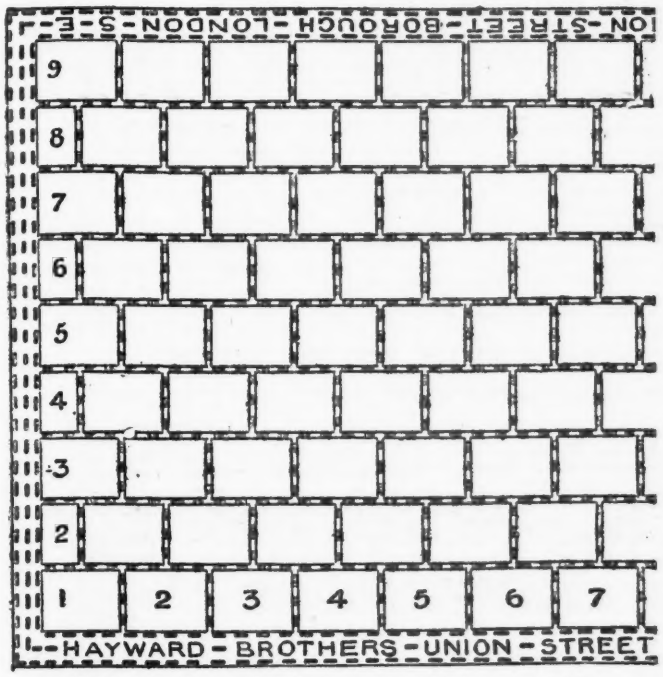

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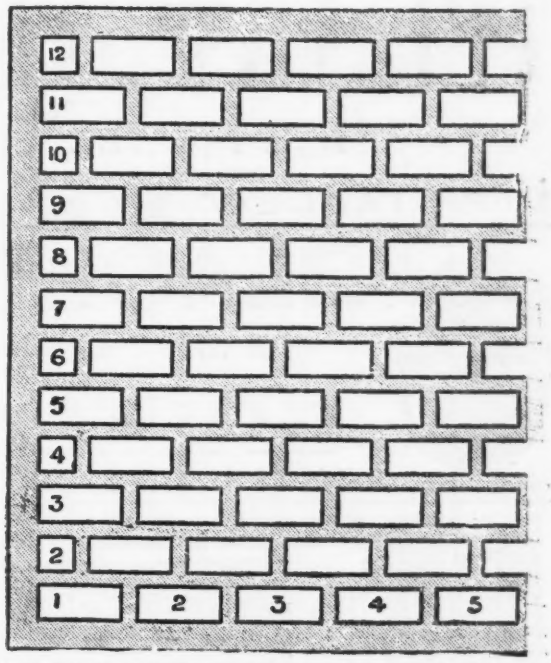

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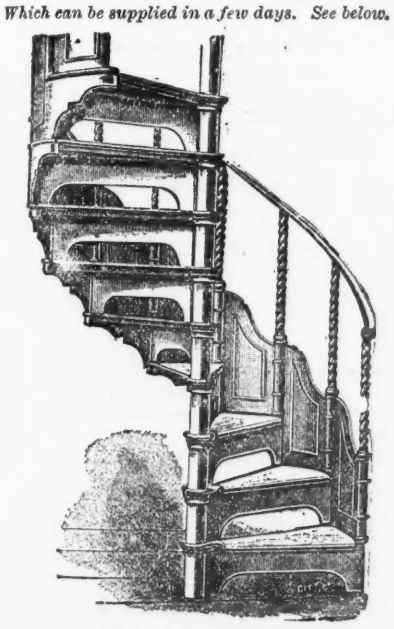

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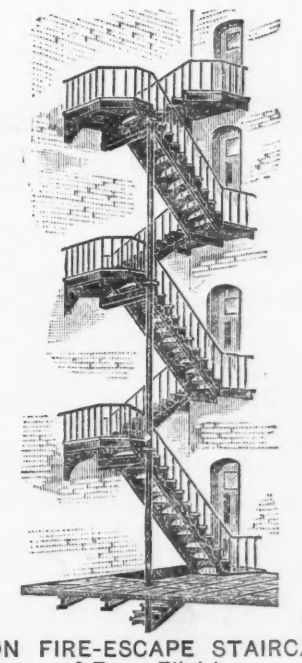

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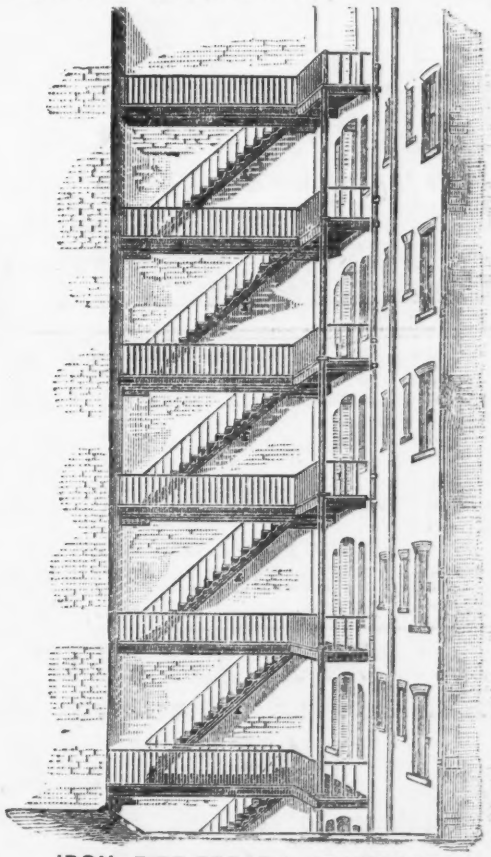

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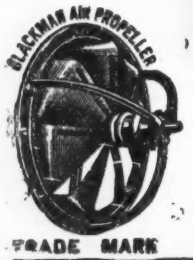

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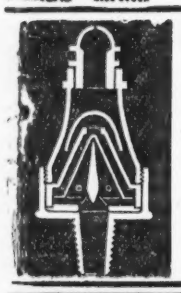

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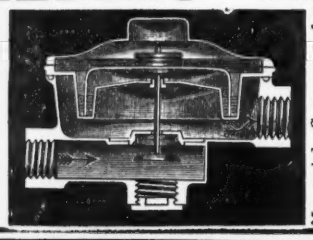

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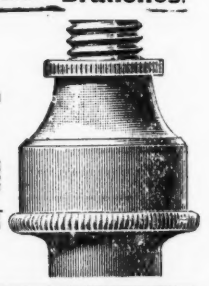

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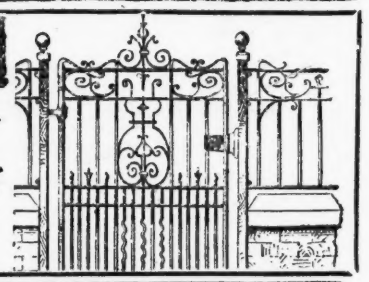

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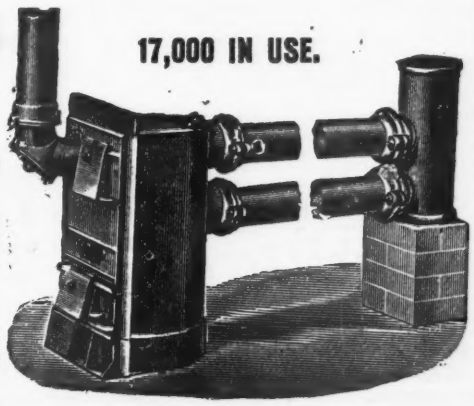

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Correspondence *relating to Advertisements should be addressed to the* **Publisher**—*not to the Editor.* (*For* **Scale of Charges** *see page* i.)

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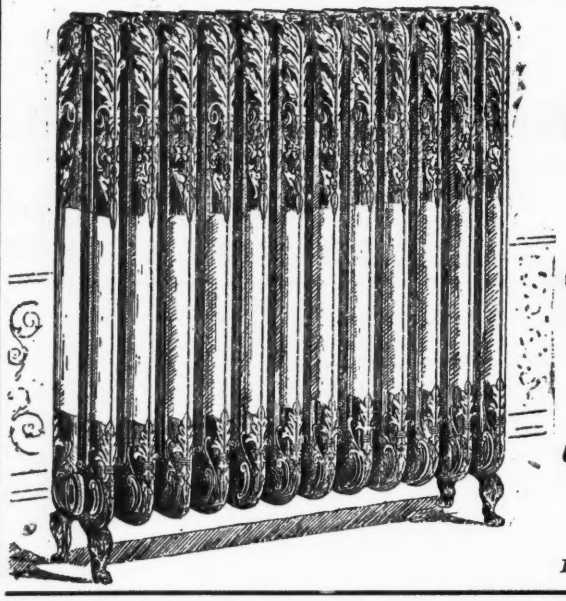

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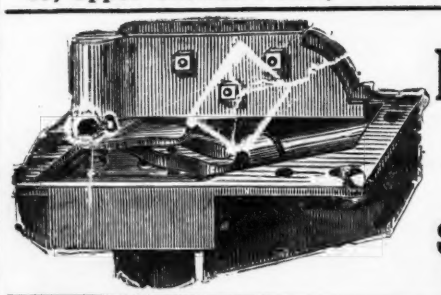

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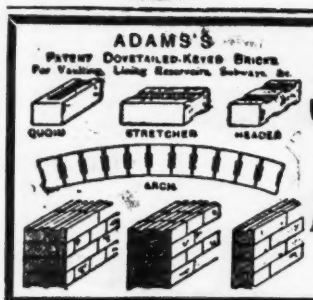

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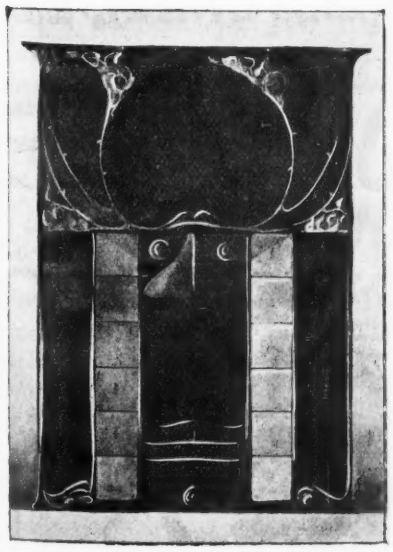

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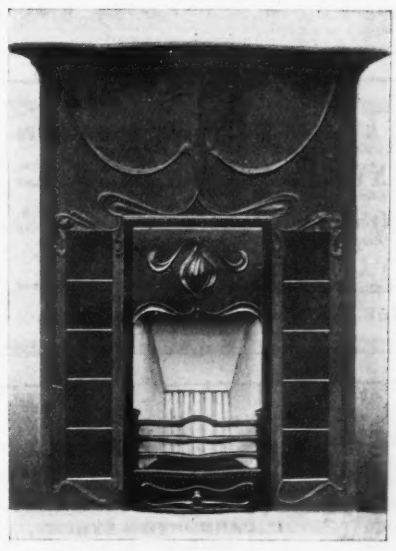

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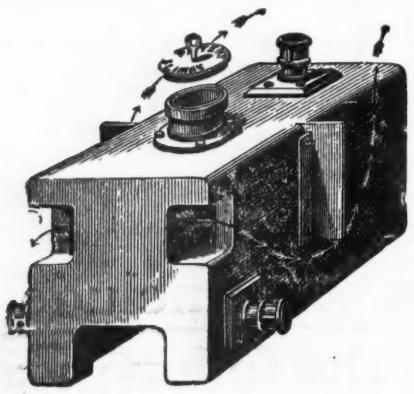

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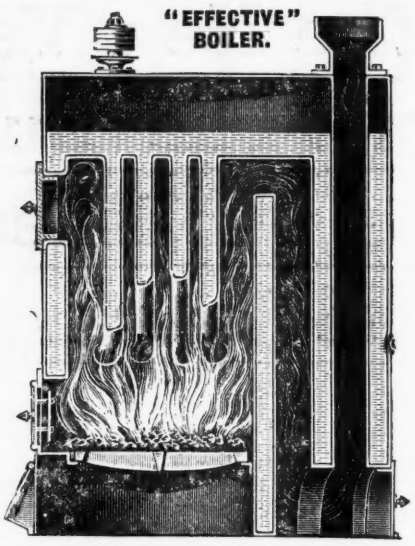

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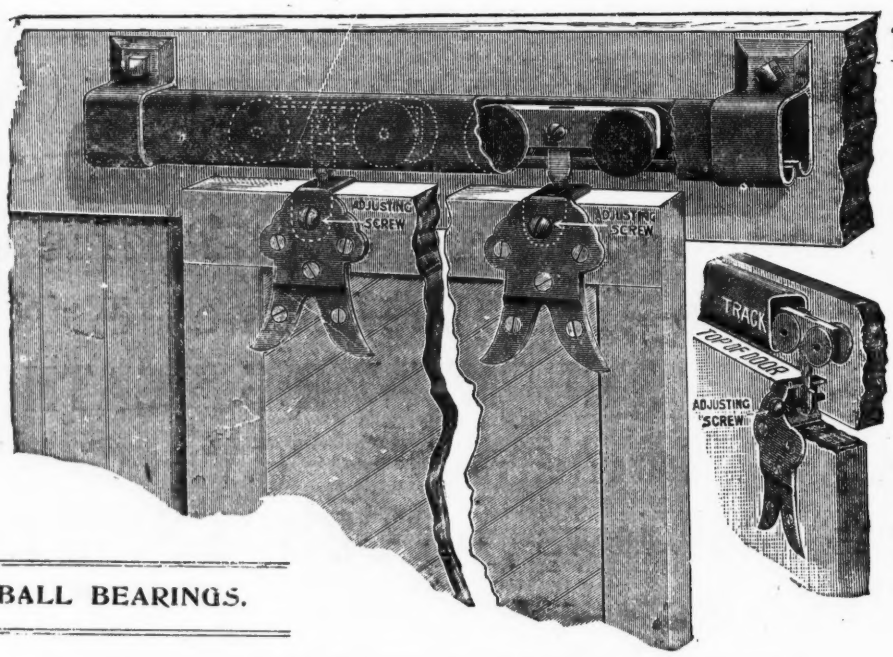

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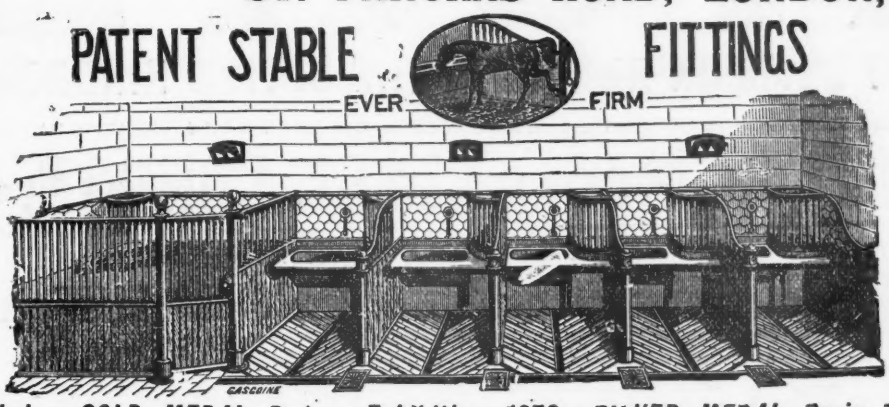

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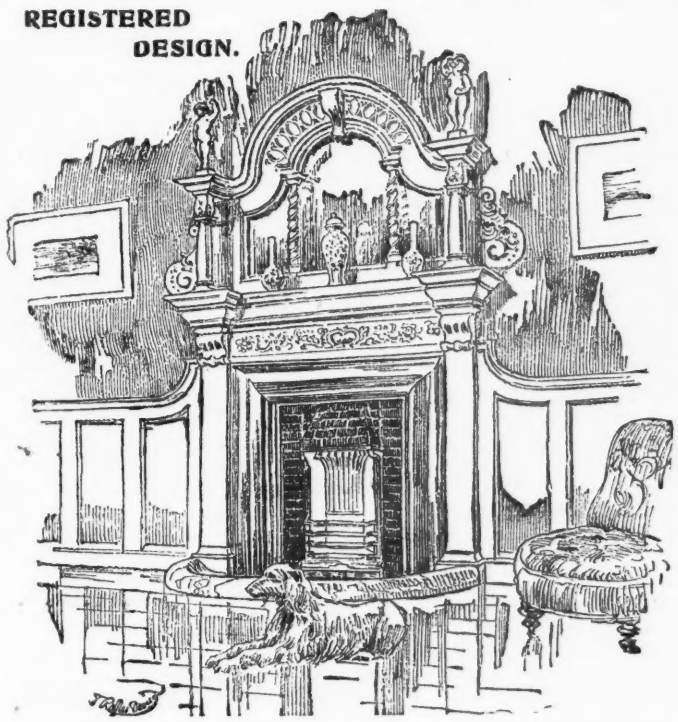

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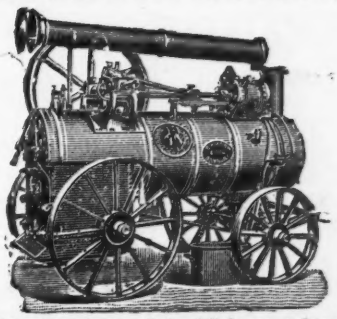

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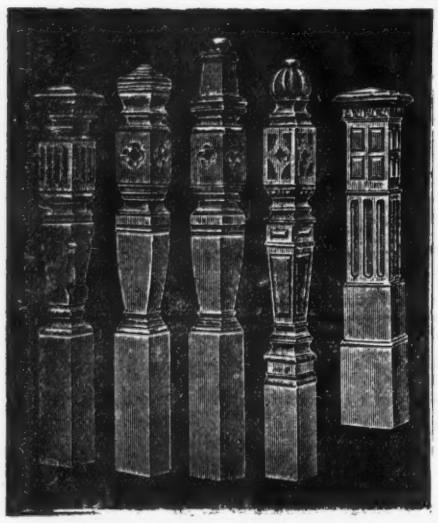

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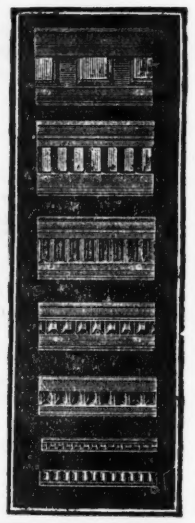

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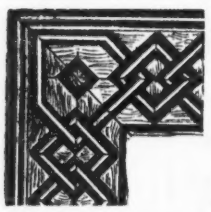

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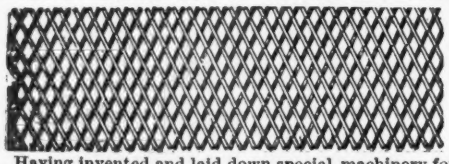

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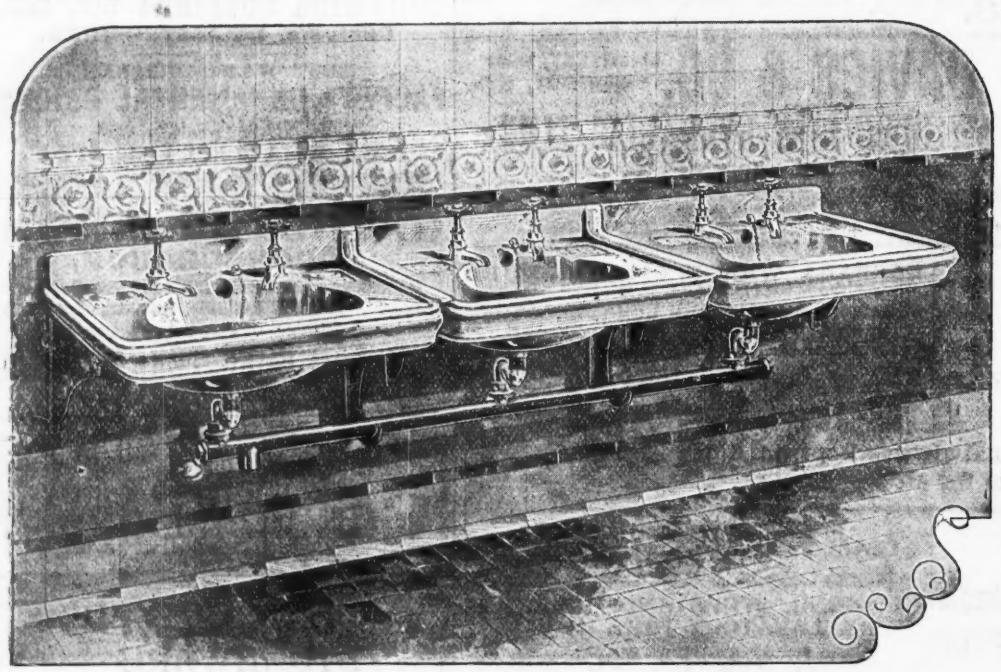

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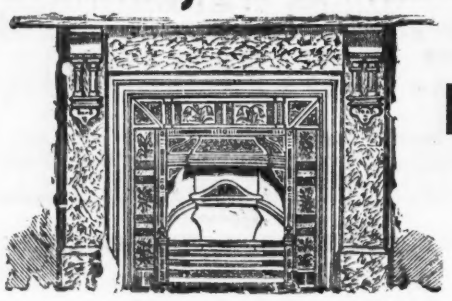

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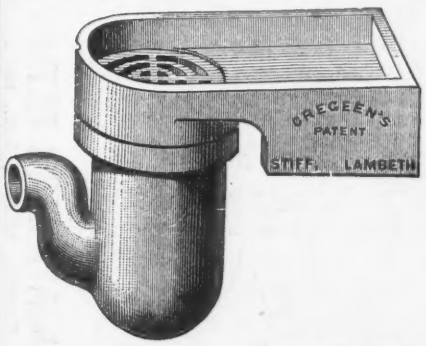

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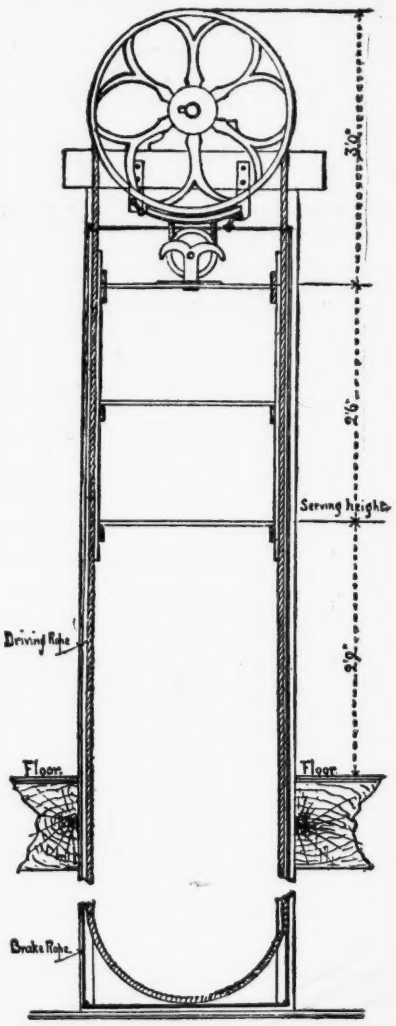

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W. EASSIE, Esq., C.E., London, *Author of "Healthy Houses," &c., Member of Sanitary Institute Cowl Testing Committee.*
"I have often made use of the '**Air-Pump**' **Ventilator,** and consider it most admirable. Its action is continuous, and it *cannot possibly get out of order.* It is decidedly the most efficient foul air withdrawing medium that I ever met with."

ERNEST TURNER, Esq., F.R.I.B.A., London, *Consulting Architect to Sanitary Institute Cowl Testing Committee.*
"**Boyle's Patent 'Air-Pump' Ventilator,** which does not revolve, is the Best Soil Pipe Ventilator that I know of."

PROFESSOR SHAW (*Compiler of the Report of Sanitary Institute Cowl Testing Committee*), *in his Report* (*Blue Book*) *to the Local Government Board on the Ventilation of Poor Law Schools* (1897), *says, re Forest Gate School:—*
"Each portion has a **Boyle's Ventilator** on the ridge. Came in after dinner, and the smell was not oppressive. **Boyle's Ventilators,** said to be a great improvement, have been there nine months."

The above report from Professor Shaw is the most valuable testimony to the efficiency of the "Air-Pump" Ventilators that has been given, owing to the conditions under which they were tested being the most severe that any ventilator could be subjected to.

Reports from Scientists, Sanitarians, and Architects.

LORD KELVIN.
"I have seen several different forms of **Mr. Boyle's 'Air-Pump' Ventilator** in actual operation, and have much pleasure in testifying to their efficiency."

LORD CLIFFORD, *Member of the House of Lords Committee on Hospitals.*
"The ventilation (on the '**Boyle**' system) seems to be perfect."

PROFESSOR SIR GEORGE AITCHISON, R.A., *Past-President Royal Institute of British Architects.*
"When I have used your up or down-cast Ventilators, they seem to have answered the purpose intended."

Sir ARTHUR W. BLOMFIELD, A.R.A., *Architect.*
"I have used the '**Air-Pump**' **Ventilator of Messrs. Robert Boyle & Son** with satisfactory results. I believe the system to be a sound and good one, and capable of varied application with success."

The Right Honourable C. SEALE-HAYNE, M.P., *Late Paymaster-General.*
"I believe it (the '**Boyle**' system of Ventilation) to be absolutely the best system of airing a public building that is known to sanitary science."

PROFESSOR BANISTER FLETCHER, F.R.I.B.A.
"I have used your '**Air-Pump**' **Ventilators** in several buildings, and find that they answer their purpose well."

PROFESSOR MACQUORN RANKIN.
"There is no time throughout the year but when there is a sufficient movement in the atmosphere to cause the '**Air-Pump**' **Ventilator** to act."

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"It is constructed on sound scientific principles, acts in strict accordance with the laws of nature, and cannot fail to operate."

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